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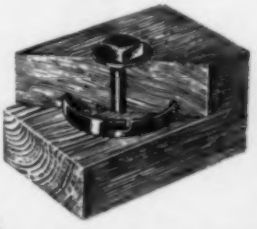

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Slums in Engineering

Adapted from a Talk Before the Society's Student Chapter at the University of Nebraska

By ROY M. GREEN, M. AM. SOC. C.E.

CONSULTING ENGINEER, PRESIDENT AND MANAGER, WESTERN LABORATORIES, INC., LINCOLN, NEBR.

AN objective view of one of our professional problems may be more clearly obtained by an analysis of a similar but impersonal situation. In considering the past and future of engineering let us seek the parallels to be found in a modern midwestern city.

St. Louis has a long and interesting history and has always been an important factor in the commerce and culture of the mid-continent area. Today, the visitor to it may conclude that the city is respectable, useful, pleasant or beautiful, depending upon which part he views. The city is easily divided into three parts: (1) the river front, (2) the old city along the river, where some of the earliest buildings still stand, and (3) the modern city.

Pitiable Decline.—The river front, today, is not pleasant or beautiful, nor is it especially respectable, but it is useful to a certain degree. Here the old city has become a dirty, disreputable slum only lightened by a few spots of historical interest. Here still stands the Cathedral where services have been held for over a hundred years. Here is the home of Eugene Field, the children's poet; the home of the Dent's where U. S. Grant was married; a formerly palatial hotel which is now a twenty-five-cent flop-house; the Old Court House, where the Dred Scott case was tried; and the site of the old Astor fur market. In these places events occurred which influenced the culture and economy of the whole country. From this same area came the income, the intellectual and spiritual stimulus which created the admirable modern city of St. Louis with its hotels, its auditorium, its parks and museums.

Building on a Notable History.—Planners of the future St. Louis no doubt realize the debt owed the old city. But this recognition does not lessen the absolute necessity of wiping out the filthy slums and making this area habitable, useful, and respectable, and in keeping with the rest of the modern city, and so to develop this area that it will not soon again become a slum.

Engineering in the United States, like the city of St. Louis, is over a hundred years old and has had a glorious past. It has contributed more than its share to the development of commerce, culture, and the economic welfare of the whole country. Along with the engineering activities of the past, have grown the professional engineering societies, whose members live in the modern city of engineering. But, unfortunately, it also has its slums.

Professional Growth Unfettered.—In the past, civil engineering has been a truly individualistic effort. Many of its notable achievements bear the stamp of single individuals. During the period of our country's expansion, the work of the civil engineer had a romantic attraction for young men as it offered adventure in the development of new lands and new enterprises. Also, it was possible for a man to realize his ambition to become a civil engineer even though he had never attended an engineering college.

Many of the older men of our generation blazed their way upward by their own intelligence, energy, vision, and industry. Because engineering was attractive and our country believed in freedom of choice, young men entered its portals who had little native ability and a very meager grasp of mathematics and the physical sciences, and no conception of the essential requirements for success.

During the period of expansion of many activities in engineering, those directing it have permitted, and even encouraged, literally thousands of meagerly equipped persons to enter the sub-professional ranks, with no apparent regard for the future effects on the profession and on the generation that was to follow.

Self-Styled "Engineers" Multiply.—This influx of sub-professional employees was at flood tide during the expansion of road construction in the United States. I know of no state highway department that did not take this easy way of getting its sub-professional work done. The same departments released great numbers of these men during the recent depression. These men later presumed that they were civil engineers; or, if more modest, only claimed to be highway engineers.

The war construction program and the draft have temporarily placed these men so that all who are even

meagerly competent are busy. At the present time, however, we find our educational institutions giving a great number of "war training courses" to teach some particular detail of engineering. In some instances students are led to believe that these "courses" are preparing them for entrance into the profession after the war. This will inevitably again flood the ranks of the sub-professional workers in engineering.

Except in periods of great expansion, this multitude, only competent to do sub-professional work, creates such a condition of congestion in the sub-professional field that it should be called "the slums in engineering." Every young man who enters the profession must first work in a sub-professional capacity and must compete with this large and poorly prepared group. Unfortunately, many of them are graduates of our engineering colleges and no doubt have assumed that their education was complete when they received their degree.

First Face the Problem of Slums.—Every professional engineer in the United States and every young man who enters or contemplates entering the profession should recognize there are slums in engineering. He should not be satisfied to live in these slums or even permit the slums to remain longer than the time necessary to eliminate them.

Are we doing everything possible to solve this problem? The Engineers' Council for Professional Development, of which the Society is a cooperating agency, is directing attention to a part of this problem. The approach of the E.C.P.D. is broad and comprehensive and includes a program for (1) the guidance of boys wishing to take engineering courses; (2) the accrediting of engineering curricula; (3) assistance to junior engineers, or professional development; and (4) professional recognition. Does the engineering profession recognize that there are slums in engineering? Engineering educators, as a group, are not zealous in pointing it out, but appear rather to avoid the subject. The E.C.P.D. program seems to be very conscious of it but does not present it as vividly as it should. Engineering employers, in the past, have ignored it in most instances. It is heartening to know, however, that many heads of engineering organizations of wide scope are now attempting to take only employees who have a basic background which will permit them to advance if they apply energy, intelligence, and studious attention to their work.

Attempts to Eliminate Slums?—It is difficult to find evidence of any well-conceived effort to eliminate these slums by the educators, the professional societies, or the individual members of these societies. This is a very difficult problem, and a solution should not be attempted by creating a condition whereby boys are deprived of their freedom of choice in their life work. The difficulty of the problem, however, should not be cause for delay in attempting its solution, even though that solution may not be of value to the present generation.

The young man entering the profession at this time should, therefore, be well aware of the fact there are slums in engineering, that these slums may become even more distasteful than they have ever been. He should be well aware that he must live in them for a certain length of time before he can be accepted in the ranks of professional engineers. He should also be well aware that he will be sure to remain in the slums if he assumes that he is prepared for engineering work simply because he is a graduate of an engineering college. The developments in engineering have been so comprehensive in the past twenty-five years that a graduate, after four years in college, may have a background for entrance into the work today which is no more complete than that of one who had a good knowledge of mathematics and a willingness to work, who was entering the field forty years ago. Civil engineering is, therefore, still a truly individualistic activity, and a man rises in the profession by his own intelligence, energy, vision, and industry.

Nebraska Section Attacks the Problem.—The period of sub-professional activities of the young engineer may very well develop into a period of discouragement and final failure. Men going through this experience often need the interest of older men in the profession. There are very few men who have achieved anything in their professional work who cannot look back and point out some older man who took a kindly interest in their work and thereby influenced their professional development. These instances of assistance have usually been accidental and the result of chance. Why cannot this type of attention be deliberate? Such a program has been tried in the Nebraska Section in an endeavor to provide, in the most natural manner, a personal adviser for graduates becoming Juniors.

This program was started a little over a year before December 7, 1941. The war has disrupted it from the point of view both of the corporate members and of the Juniors, but some good may have been done.

Specific Helps to Juniors.—Some of the earliest problems of ethics have been presented by individual Juniors and have been given a careful discussion by their personal advisers. Inquiries have been received seeking advice on books to be studied in order to improve the equipment of Juniors. A committee of a Local Section can more easily find men to advise on proper reading than can the Junior himself, and the bibliography of E.C.P.D. has been helpful. Correspondence has been carried on by corporate members with Juniors in active service with the U.S. Army, and the younger men have expressed their appreciation of this interest.

These are rather intangible evidences of the value of such a program, but its worth, like that of all personal programs, cannot be definitely established in any statistical way.

These Problems Are Persistent.—The corporate members of the Society may well ask themselves two questions. Should we try to work out some method by which we can ultimately eliminate the slums in engineering and make the sub-professional activities of our younger men the proving period which will really develop rather than endanger them? Is it worth while to pay more attention to the personal development of the young men who are in this period of their careers? These are questions for today, for next year, and for years to come.

The young men might also ask themselves a question: "Have I the courage, intelligence, energy, vision, and industry to help clean up this bad situation by developing myself rapidly, so that I will have to remain in sub-professional work only as long as is required to earn professional recognition?"

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NUMBER 7

Norfolk and Western Railway Reconstructs Roanoke Yard

Coal Shipments Are Facilitated by Five-Million-Dollar Project

By FRANK P. TURNER, M. AM. SOC. C.E.
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GREATLY reduced classification time has been made possible by the new facilities of the Norfolk and Western's Roanoke, Va., freight yard. A 100% increase in the number of classification tracks, improved hump facilities, and the installation of car retarders are features of the remodeled yard. As explained by Mr. Turner, a total of 47 classifications is possible from the hump. Mr. Turner's paper was originally presented before a meeting of the Virginia Section of the Society.

ONE of the largest improvements undertaken by railroads in recent years is the remodeling of the Roanoke Yard of the Norfolk and Western Railway. To achieve complete modernization, electro-pneumatic car retarders were installed for the control of humped cars. This car retarder layout on the 50 classification tracks is now demonstrating its worth in the efficient handling of the present all-time maximum traffic in coal, time freight, and miscellaneous freight.

The new yard (Fig. 1) also contains, to serve eastbound traffic, two groups of receiving-yard tracks, each track with capacity for trains of 110 to 130 cars. Coal trains from the West are usually made up of about 100 cars. The total capacity of the receiving yard is 2,430 cars. A two-track hump connects this receiving yard with the classification yards, where two groups of tracks, with a capacity of 24 to 40 cars on each track, extend east to departure yards. A parallel running track is provided along the south side of the yard.

For westbound traffic, a 10-track empty-car yard has been added on the north side of the eastbound receiving yard. Each track has capacity for a 155 to 160-car train. The total capacity of this yard is 1,565.

An enlarged and revised engine service yard provides eight 12-in. standpipes, ash pits and hoists, inspection pits for locomotives, coaling station, and washing platforms. In this yard also are covered inspection pits for making light repairs and adjustments, a wash and locker room for employees, enginemen's register building, and a service building for car inspectors.

Operation of the yard has been speeded up by the installation of several new facilities. A communications system now transmits instructions from the yardmaster to the humpmaster, and from the humpmaster or conductor to the car-retarder operators, to the humping locomotives and to men in the classification yard. Two new 300-ton capacity, 4-section, track scales are equipped for motion-weighing. Floodlight towers light all the ladder tracks, switches, and other facilities.

The grading for the new classification yard was done without interference with existing tracks or the operation of trains. In widening fills for a distance of approximately one mile, it was necessary to change about 1,000 ft of the channel in the Roanoke River to provide space for additional tracks.

During the period when grading for the new facilities was in progress, a large quantity of concrete work was

A COAL TRAIN APPROACHING THE HUMP FROM THE EASTBOUND RECEIVING YARD
The Two Tracks in Center Are the Hump Tracks

FIG. 1. NEW ROANOKE YARD OF NORFOLK AND WESTERN RAILWAY, ROANOKE, VA.

completed. This included the extension of an arch culvert under the eastbound receiving yard, the extension of a street underpass which runs beneath the hump, and an underpass for the use of employees and trucks entering the shops and storehouse.

Electro-pneumatic car retarders (Fig. 2) control the speed of cars as they enter the classification yard after passing over the hump. On each of the two tracks passing over the hump there is one short retarder above the scale, one of intermediate length below the scale, and a long one on each of the two diverging tracks that lead into the north and south classification yards. Four retarders in each yard then control car speed into the classification tracks.

The approach grade to the summit of the hump is 2.4%. East of the apex of the hump, a down grade of −2.6% carries the cars to the scales which are on a −0.75% grade. A slope of −3.77% carries cars away from the scales to the classification tracks. Here the slope is reduced to 0.232, which maintains the desirable speed. Inasmuch as all types of loaded cars, as well as empty cars, are classified in this yard, the layout of tracks and profile grades has been arranged so that with the use of car retarders the speeds that have been found to be most desirable for the complete filling of all tracks and for coupling without damaging the equipment can be maintained.

In the operation of the Norfolk and Western's Portsmouth yard, it was definitely established that the most satisfactory non-accelerating grades on straight lines or light curves, for the movement of cars in the classification yard, after passing the last retarder and for coupling to the car ahead, without damaging equipment, varied from 0.15 to 0.20%. The grades on the Roanoke classification tracks conform in general to those figures.

On the lower end of the classification and departure tracks, the average down grade varies from 0.6% to 0.7%, continuing to the yard limits. In order, therefore, to keep cars from rolling over on to these grades, after passing the last car retarder, a grade of +0.42% on all classification tracks was introduced. In case the speed of any car proves to be sufficient to roll over the adverse grade, handplaced skates are used to stop it while on certain tracks derailers have been installed for the same purpose.

Three towers are required to operate the retarders. Tower "A" is so placed that the operator can observe each car as it is uncoupled in passing over the hump, regulate the speed, and set the power-operated switches. The cars pass through the 10-cylinder retarder (34 ft 6 in. long) above the scale, the 22-cylinder retarder (72 ft 6 in. long) directly below the scale, and the 32-cylinder retarder (103 ft long) on the main leads to the north and south groups of tracks. The judgment of this operator determines what air pressures should be used in each case, depending upon the type of the car and the amount of its lading. Operators in towers "B" and "C" each control the speed and switching of the car as it passes through one of the four 22-cylinder retarders, each 72 ft in length, that are located on the tracks leading to groups of 5 or 6 classification tracks.

CARS ROLLING DOWN THE HUMP TO EASTBOUND CLASSIFICATION YARD
Retarders, Track Scales, and Operators' Houses Shown

The retarders and switches are operated by compressed air machines which are controlled by electric contact. An air cylinder of the retarder, with appropriate levers, applies the pressure to brake shoes against both sides of the car wheel. Each cylinder applies the power to a shoe 6 ft 3 in. long.

In his position at the apex of the hump, the humpmaster has direct control of cars as they move over the hump and are classified according to the switch list. His instructions can be communicated to the humping engine working on the receiving yard, through a system of loudspeaker telephones installed on each humping locomotive, in each retarder tower, and at designated points in the receiving yard. Sending and receiving equipment is located in the hump office and in each of the humping locomotives. Thus messages may be delivered by electrical connection through the rails, without

stopping the locomotive. The engineman is also guided by lights, known as "humping" and "repeater" signals, located on poles spaced at intervals. The equipment consists of one hump signal and four repeater signals in both north and south receiving yards. There is also a trimmer signal in the classification yard which provides for control of a locomotive when it is necessary for it to pass down into this yard.

The weighmaster and the yardmaster share an office near the apex of the hump. It is the responsibility of the former to see that each car is weighed and the weight recorded on the motion weighing track scales. Each scale has a weigh rail section with a net length of 72 ft, connected to approach rails by intermediate flexible rail sections and easer joint bars. This prevents operating cars over open joints and eliminates vibration from weigh-bridge to scale knife edges and levers. Each scale is equipped with timing devices to insure proper operating speeds when cars are weighed. The length of the weigh rail is such that the longest car may remain on the scale the minimum time specified to obtain the correct weight without delaying the speed of operation. Cars that do not require weighing are diverted over the dead rail track, which likewise crosses the scale and leads directly on to the rails below the scale. From 1,800 to 2,000 cars are handled and classified in 24 hours, and about one-third of these are weighed. The capacity of the facilities is actually greater than this.

How the facilities are used can be illustrated by tracing the movement of one train through the yard. At the extreme west end of the Roanoke improvement, a main-line train enters the receiving yard. The yardmaster and humpmaster determine which track the incoming train should use, and the switches are thrown accordingly. The train moves eastward into the receiving yard until the locomotive approaches the clearance point at the east end of the receiving-yard tracks. At that point the engineman is relieved and the hostler moves the locomotive to the roundhouse.

The conductor of the incoming train delivers his switch list containing the car initials, number, lading, and weight, to the yardmaster at the scale house. This switch list is immediately teletyped in the yardmaster's office, and one copy furnished to the humpmaster. Teletyped copies are reproduced in each of the car operator towers and in the general yardmaster's office. These copies are later used by the humpmaster and by each car-retarder operator in the towers for classifying the cars as they pass over the hump into the classification yard.

CAR RETARDERS APPLY A BRAKE SHOE TO BOTH SIDES OF ALL WHEELS

Operators in Tower Control Pressure Applied to Brake Shoes

Behind the incoming train of cars, the humping engine enters the receiving yard and upon instructions from the humpmaster pushes the train out of the receiving yard and over one of the humping tracks at speeds of approximately $2^1/_2$ miles an hour. Each approaching car is uncoupled as it passes over the hump and glides down the steep grade leading eastward.

The 2.6% down-grade causes the car immediately to increase its speed and as it passes through the 10-cylinder retarder, speed is reduced, provided it is excessive, until this car passes across the scale at approximately 5 miles an hour. The speed of each car that is weighed is so regulated that the weight is obtained before the front wheel of the car passes off the weigh rail, and likewise before the front wheel of the following car passes on to the weigh rail.

In the classification yard, the arrangement of tracks provides for a total of 47 classifications. The cars for several destinations on any given division are so arranged as to be conveniently made up into trains for that territory by the minimum amount of shifting through the four departure tracks at the end of each of the two groups of classification tracks. Cars are likewise grouped for convenient forwarding to the Roanoke freight house, delivery to industries in Roanoke, and to the Roanoke car shops.

The locomotive water supply at the shops has been improved by laying approximately 2,000 ft of additional 18-in. and 14-in. cast-iron pipe lines. These supply the new arrangement of standpipes. The arrangement is such that in any part of the shop yard an abundant supply of water is available.

ENGINE SERVICE TRACKS AND FACILITIES

One of the most important elements that has contributed to the increased capacity of the Roanoke yard is the enlargement and redesign of engine service tracks

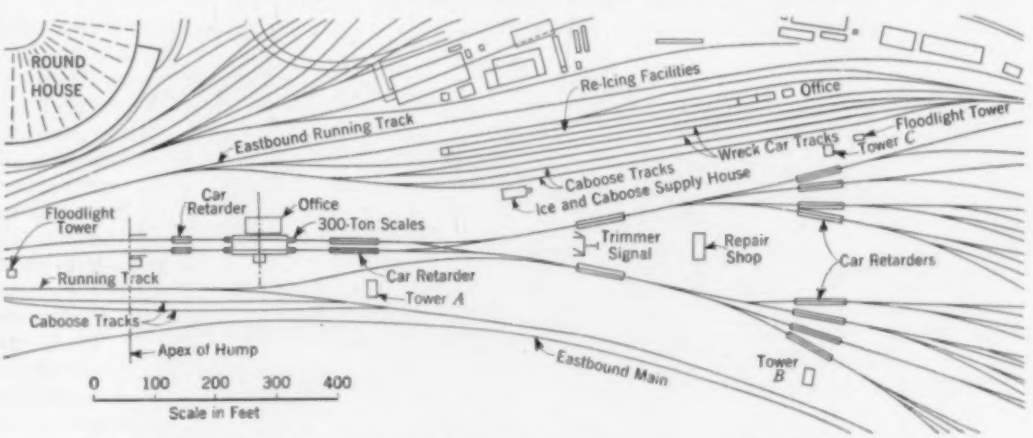

FIG. 2. AREA OF ROANOKE YARD SHOWING ARRANGEMENT OF CAR-RETARDER SYSTEM

and facilities for servicing locomotives (Fig. 3). This engine terminal was designed originally for the handling and turning of a maximum of 80 locomotives per 24-hour day. The original plans included a second roundhouse and turntable when business increased so that more engines had to be turned.

Shortly after the present war broke out, increases in business made it necessary to turn more than 100 engines a day. But during the interval between 1918, when the original facilities were planned and built, and 1940, the locomotives had changed greatly. When engines of the type in common use in 1918 came in from a road trip, it was usually necessary to put them in the roundhouse and do some adjusting and repairing before they started another trip. By 1940, most of the work through this terminal was being done by modern engines, equipped with roller bearings and all the other latest improvements. When such an engine comes in from a run, it needs only to have its lubricators filled, its ash pans dumped, and sometimes its fire cleaned; and to be given a light cleaning to keep up its "morale," also a new supply of coal and water. It is then ready to go back to work. Where the proper facilities exist, all this can be done very quickly outside the roundhouse.

AN ENCLOSED INSPECTION AND REPAIR PIT IN THE NEW ENGINE SERVICE YARD
Cooling Station in Background

In order to service these modern types of locomotives properly and promptly, the layout of the engine terminal was revised so as to provide an "assembly line" system. The incoming engine passes from the receiving track over an inspection pit, where it is given an underneath, side, and overhead inspection and its needs listed; thence to an ash pit where its pans are dumped and fire cleaned, if necessary; thence to a washing platform where it can quickly be given a hot bath and rubdown; thence to the turntable; thence to a service house where, protected from the weather, it can quickly receive the necessary lubrication and small adjustments, for which roundhouse facilities are not necessary; thence direct to a standpipe and coaling station; and thence on to the outgoing track ready to start another trip. The terminal time of the engine is thus greatly shortened, an important advantage for engines making two or three road trips every 24 hours.

By means of these improvements, this terminal, originally designed for turning a maximum of 80 locomotives a day, is now comfortably turning well above 120 engines a day and without increasing its basic coal, water, turntable, and roundhouse facilities. It is these improved locomotive manufacturing, repairing, and servicing facilities which have enabled the Norfolk and Western, with its present unprecedented volume of traffic, not only to take care of its own locomotive requirements, but also to undertake in a substantial way the overhauling and repairing of locomotives for less completely equipped neighbor railroads.

The quantities of materials excavated and moved in connection with the grading for the new yard amounted to over 1,623,000 cu yd of excavation of all classes, and the masonry required the mixing and placing of over 11,000 cu yd of concrete, leaving out the foundations of some of the buildings not yet completed. The new tracks and track changes required the use of 350 frogs, 350 switches, and about 17,000 gross tons of rail. The entire cost of the improvements will be approximately $5,000,000.

The planning and construction of these improvements were directed by the Engineering Department of the Railway Company, under W. P. Wiltsee, M. Am. Soc. C.E., Chief Engineer, in cooperation with and on advice from the Operating, Transportation, Motive Power, and Signal departments of the Railway Company. The field work was supervised by O. V. Parsons and W. H. Bettis, Assistant Engineers, and J. P. Maloney, Resident Engineer. The engineers for the Union Switch and Signal Company participated in the design and selection of grades for the classification tracks and the location of the car retarders, which were furnished and installed by that company as was also the communications system. The contractor for the grading of the new yard was the Ralph E. Mills Company, of Roanoke. For the principal part of the concrete work, water pipe lines, and drain pipes, the contractor was M. S. Hudgins, also of Roanoke. The contractor for the foundations and some of the engine service buildings was B. F. Parrott and Company, of Roanoke. J. P. Pettyjohn and Company, of Lynchburg, Va., constructed other service buildings, and Martin Brothers, of Roanoke, are the contractors on the roundhouse extension.

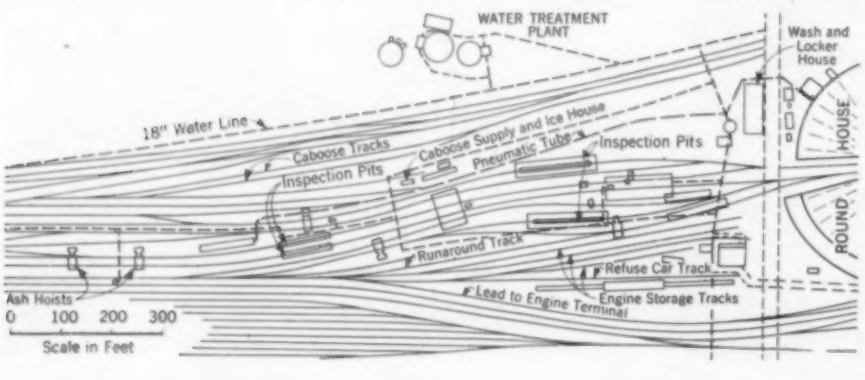

FIG. 3. ENGINE SERVICE YARD AT THE ROANOKE YARD

The Design of Recent TVA Projects

V. The Fontana Project

By CALVIN V. DAVIS *and* ADOLF A. MEYER, MEMBERS AM. SOC. C.E.

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AS part of the emergency power program for national defense, the Tennessee Valley Authority started in 1942 to construct the Fontana project on the Little Tennessee River under an accelerated schedule. The development is about 60 miles above the mouth of the river, a short distance above the head of the existing Cheoah Reservoir. With a maximum height of 470 ft, the dam will be (1944) the highest east of the Rockies. The first article of this series appeared in the March issue.

OF the five main tributary storage developments mentioned in the initial article of this series, three are located in the wide valley between the Cumberland and the Smoky Mountains, and the remaining two, Hiwassee and Fontana, are in gorges where the river passes through the mountains. To obtain sufficient storage capacity in reservoirs within such narrow valleys with steep river slopes, the impounding structures must necessarily be of relatively great height. From the economic standpoint, however, this disadvantage is compensated for by the comparatively low cost of reservoir rights and adjustments, and by the availability of a substantial head for power production directly at the dam.

Fontana Dam is in the rugged mountain section adjacent to the Smoky Mountain National Park. The drainage area of the river at the site is 1,571 sq miles, and the stream flow averages 3,970 cu ft per sec. The reservoir will have a usable storage capacity of 1,200,000 acre-ft, equivalent to 42% of the average annual flow. Practically all of the drop between the reservoir, at El. 1,710, and the mouth of the Tennessee, at El. 310, will be used at plants now existing or under construction. The project is strategically located for integrated operation with five existing developments of the Aluminum Company on the Little Tennessee watershed and will increase power production by 2,000,000,000 kwhr during a year of average stream flow.

CONCRETE DAM DOMINATES SITE

The dominant element of the project is the main dam containing 2,600,000 cu yd of concrete, scheduled for placement in 14 months. Consequently the essential requirement of the design was to provide a simple structure composed of convenient-sized identical elements conducive to large-scale mass production methods. It should be free from localized complications such as sluice conduit liners, embedded parts, or river-diversion notches, which require special treatment and retard the tempo of production, and should have simple positive provision for the limitation of stresses due to temperature change in the concrete.

At the site the valley does not have sufficient width to accommodate both a power station and an energy dissipation structure of the type necessary for an overflow spillway capable of passing the maximum design flood. The adopted arrangement, Fig. 1, places the power station at the toe of the dam, and this structure, with the adjacent switchyard, occupies the width of the canyon floor. All the available head down to the Cheoah pool is utilized by a tailrace channel excavated in the bed of the river. This results in a more economical layout than the use of an intake structure, power tunnel, and surge tank, but requires the embedment of three penstock liners in the dam. These, however, constitute the only local impediment to a program of high-speed concreting.

The location chosen for the power station requires that all outlet works, temporary and permanent, be removed from the main dam; but this feature results in practically complete conformity with the basic requirement that the structure be simple and free from all conduit liners, diversion notches, and specialized local treatments that cause such disproportionate delay in concrete placement. Two tunnels of 37-ft bore through the left abutment permit construction with a single diversion stage. These tunnels are then converted to function as the outlet from the main spillway. This spillway and its sluice gates are located in the low concrete structure built along the top of the ridge at the left abutment.

Similarly, railroad access between the siding connecting to a main line upstream of the dam, and the construction yards, downstream from the dam, is secured through a rock tunnel at the dam site in order to avoid all interference with excavation and concreting operations. After this tunnel has served its purpose as a traffic artery during construction, it will be converted to act as a permanent low-level outlet.

The main dam is a gravity bulkhead section with a maximum height of 470 ft and a length at the crest, exclusive of side abutments, of 1,750 ft. The rock at the site consists of quartzite and phyllite, with many intermediate gradations. The formation as a whole is of very great strength, the quartzite testing over 22,000 lb per

SITE OF FONTANA DAM WITH EXCAVATION UNDER WAY

Outlet to Diversion Tunnel at Center

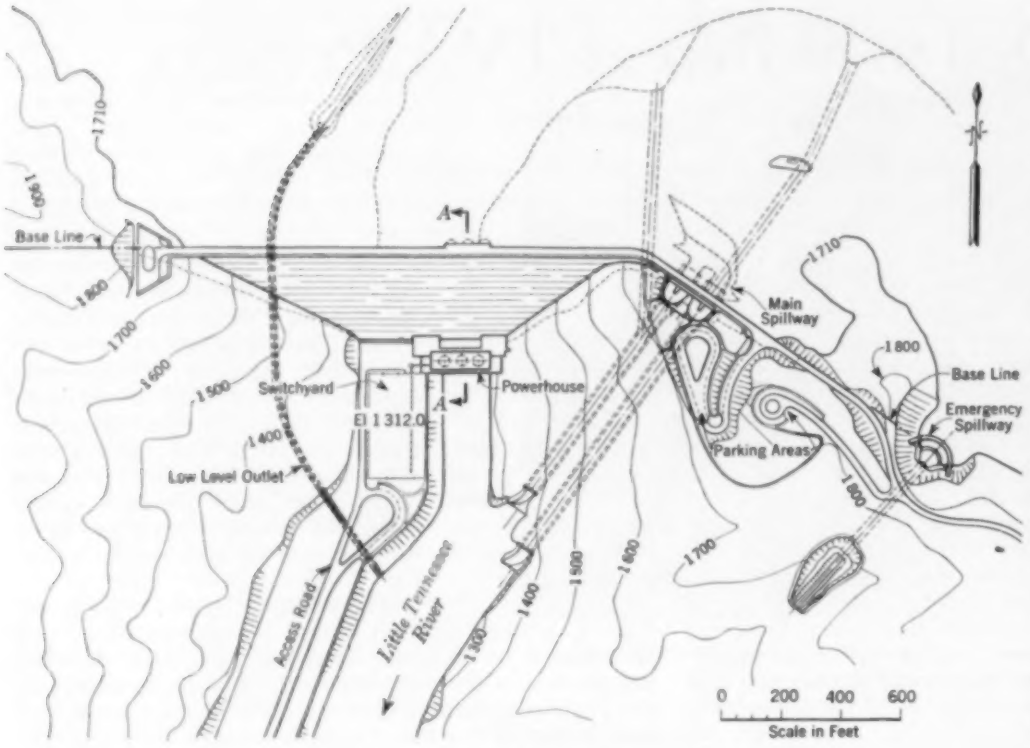


FIG. 1. GENERAL SITE PLAN OF FONTANA DAM

sq in. and the phyllite over 12,000 lb per sq in. in compression. However, there is considerable jointing in the rock, and weathering along the joints to appreciable depths. For this reason consolidation grouting over the full area of the foundation is necessary. Near the upstream face a grout curtain extending 150 ft below the foundation is provided. Back of this curtain drain holes $3^1/_2$ in. in diameter, 10 ft on centers, extending 50 ft into the rock, will relieve uplift pressure and drain seepage water into the gallery.

The dam section, Fig. 2, is a triangle with a downstream back batter of 0.76 and the apex 2 ft above maximum surcharge pool elevation. The upstream face is vertical except for a 5-on-1 batter for the lower 100 ft above the rock in the maximum section. The maximum principal stress from cantilever action is 510 lb per sq in. Based on an ultimate allowable load of $(600 + 0.65p)$ lb per sq in., the shear friction safety factor is 6.

JOINTS REDUCE TEMPERATURE STRESSES

The dam is divided into blocks by transverse contraction joints 50 ft on centers and by three temporary longitudinal joints 83 to 103 ft on centers. The longitudinal joints are introduced as a means of reducing tensile stresses developed as the dam cools from its maximum to its final stable temperature.

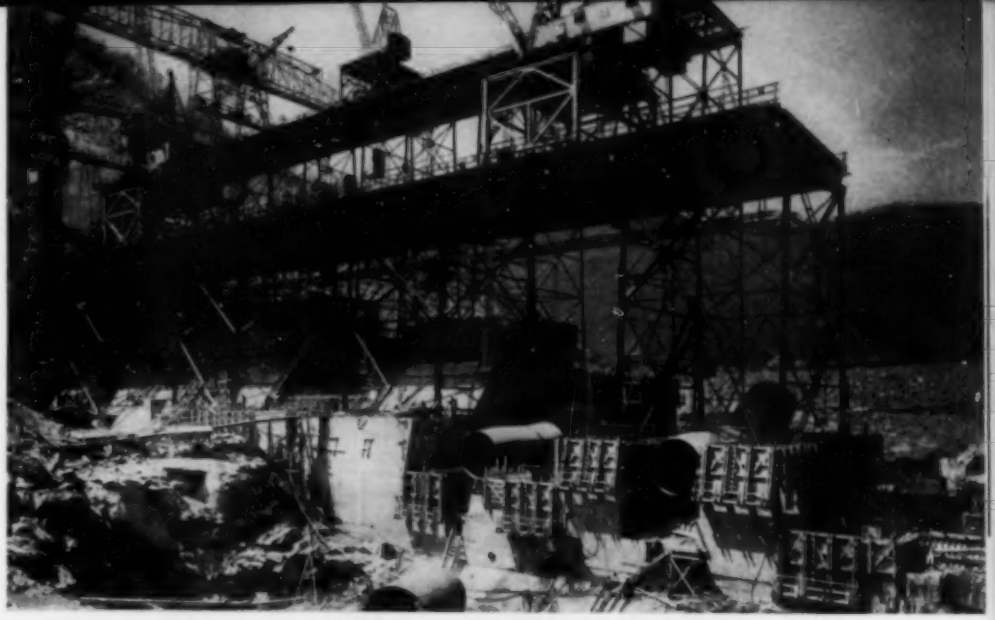
In general the means of limiting tensile stresses from shrinkage follow the procedure developed by the Bureau of Reclamation for large dams. The highest stresses occur near the foundation, where the restraining influence of the rock prevents any yielding to relieve volume changes. Above the foundation the stresses gradually decrease. The distance at which they become negligible is a function of the base length of the dam block. By introducing these longitudinal contraction joints, the restrained zones are substantially reduced. In a dam without such joints, there would be a substantial restraint caused by the foundation in 50% of the volume. With these joints, the influence of foundation restraint is reduced to about 15% of the volume. By careful arrangement of the pouring schedule, and by artificial cooling of the concrete placed within these restrained areas, shrinkage stresses are kept within safe limits.

In order to permit reconstituting the component sections of the dam into a structural unit before applying reservoir load, a cooling system to extract all heat above final stable temperature is being installed throughout the concrete mass. Cooling coils made up of thin-walled steel tubing, 1 in. in outside diameter 17 gage, are being placed at the bottom of each lift. The typical lift is 5 ft high, although during the warm season $2^1/_2$-ft lifts are being used in highly restrained zones. The standard spacing of the cooling coils is 6 ft 3 in., but closer spacings are used in highly restrained zones to reduce temperature rise and, hence, subsequent temperature drop. Normally river water is used for cooling. A refrigeration plant of 250-ton capacity is, however, provided to supplement this and to function under conditions requiring colder water than may be available from the river.

TWO TYPES OF KEYS ADOPTED

For the keys in the longitudinal contraction joints, which have to transfer shears across the joints after grouting, two types have been adopted, as shown in Fig. 2. At the two downstream joints, where high shear stresses prevail, the keys are shaped to obtain high efficiency. But because moving of the forms to which these deep keys are attached involves extra expense during construction, a simpler but less efficient key was adopted at the upstream joint, where stresses of much lower intensity have to be transferred. As the upstream joint represents more than half the joint area, it is evident that a worthwhile saving is effected by using the two different types of keys.

The transverse joints are to be left permanently open as contraction joints, except that in a zone approximately 40 ft high, near the base, all joints will be keyed and grouted. This small amount of joint treatment is considered helpful during the grouting of the longitudinal joints. In a small area near the upstream face the grouting zone is extended to El. 1,400 in order to seal the joints effectively where maximum reservoir pressure exists. Above the grouting zone, two copper seals are used in the contraction joints. Between the seals an open hole 8-in. in diameter is provided which could be used for an asphalt stop in case of seal failure. In order to facilitate inspection and possible repair work in the sealing zone, there is a shaft 3 ft in diameter back of the seals. To relieve uplift pressure within the concrete itself, formed holes, 8 in. in diameter, spaced 10 ft on centers, are provided over the full height of the dam.



FONTANA DAM LOOKING UPSTREAM FROM LEFT BANK

Penstocks Nos. 1 and 2 Being Erected and 100,000 Cu Yd of Concrete in Place

The mass concrete contains about 0.8 bbl of cement per cubic yard, and the face concrete approximately 1.1 bbl. Because of war conditions, no low-heat cement is available, and Type B "modified" portland cement is being used throughout.

Coarse and fine aggregate are processed from rock quarried about a mile below the dam. The concrete is being placed to El. 1,475 from a trestle located between the two upstream longitudinal joints. The trestle will be raised later to a higher level to complete concreting to the top of the dam. This main trestle is supplemented by a smaller and shorter structure near the toe of the dam.

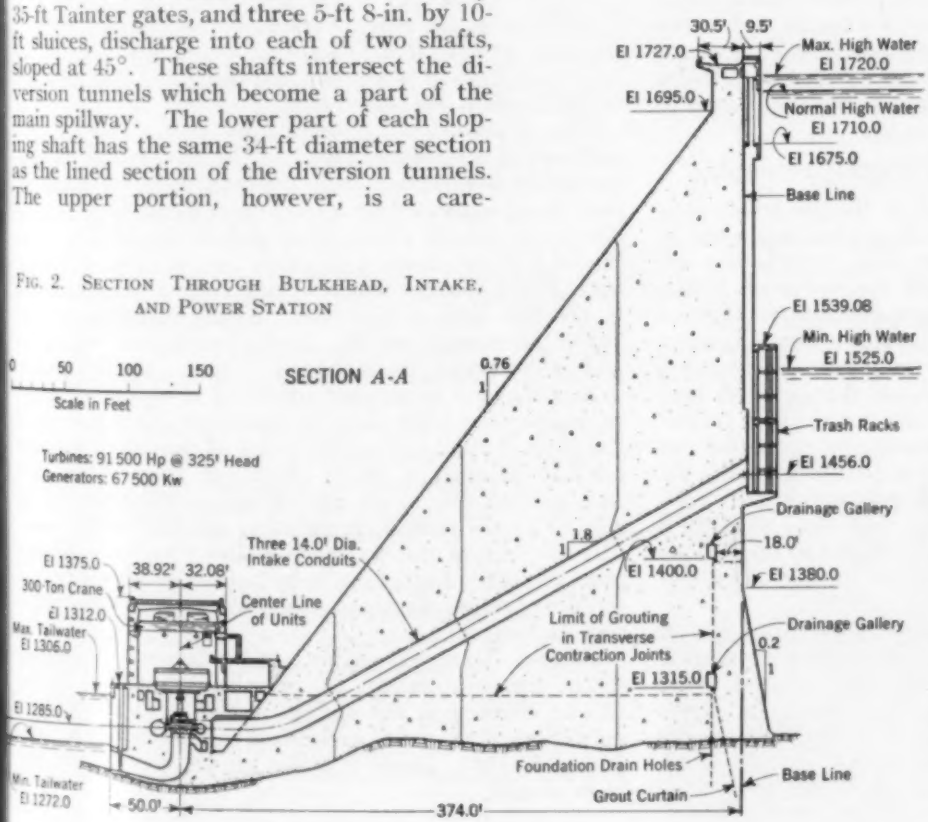
Regulation of the reservoir level is provided by the outlet works, to conform with the requirements of operation for flood control and for the safe discharge of the maximum flood to be expected. This design flood is based on an assumed storm with a runoff of 10 in. in about four days, resulting in a peak inflow of 239,000 cu ft per sec, which equals 6,000 $\sqrt{\text{drainage area}}$.

Maximum controlled reservoir level is at El. 1,710. Reservoir adjustments provide for a surcharge of 10 ft above this level. This surcharge permits the storage of 115,000 acre-ft. It will allow the flood crest to be so timed that it will not add to the crest in the main river but will reduce the discharge for the maximum flood inflow to 199,000 cu ft per sec.

It has already been noted that all outlet works are removed from the main dam. Sections through the three groups of structures provided are shown in Fig. 3.

The main spillway gates and sluice outlets are located over the two diversion tunnels. Two 35 by 35-ft Tainter gates, and three 5-ft 8-in. by 10-ft sluices, discharge into each of two shafts, sloped at 45°. These shafts intersect the diversion tunnels which become a part of the main spillway. The lower part of each sloping shaft has the same 34-ft diameter section as the lined section of the diversion tunnels. The upper portion, however, is a carefully shaped funnel section designed, in accordance with extensive tests in the Hydraulic Laboratory, to guide the water without disturbance from the gates or the sluices, or both, to the standard round section. To avoid choking of the flow in the shaft, the round section is reached only at El. 1,482, which is 228 ft below the normal pool level.

FIG. 2. SECTION THROUGH BULKHEAD, INTAKE, AND POWER STATION



FOUR TAINTER GATES DESIGNED TO SECURE EFFECTIVE OPERATION

The four Tainter gates are set to form two converging spillway sections to give optimum conditions at the funnel transition. These gates have individual hoists, but a single motor-operated or hand-operated auxiliary handles each pair so that gates will always be opened the same amount, and flow into the funnel will be symmetrical. The gates are provided with a special overflow crest at El. 1,710, designed to permit surcharging the reservoir to El. 1,715 without operating the gates. This adds to the flood control benefits of the reservoir and also protects the gate against damage if for any reason it cannot be operated.

The six sluices in the main spillway are located with the center line at El. 1,590. They are able to discharge 23,000 cu ft per sec for reservoir level at El. 1,710, and 20,000 cu ft per sec for reservoir at El. 1,685. Thus they provide considerable control of the reservoir when its level is below the spillway crest. Each sluice is protected by trash racks and controlled by hydraulically operated slide gates arranged in duplicate. Gates will be operated to provide symmetrical flow to the tunnel. To maintain positive pressures in the sluiceway during operation, a 20% contraction of its area is introduced at the outlet end.

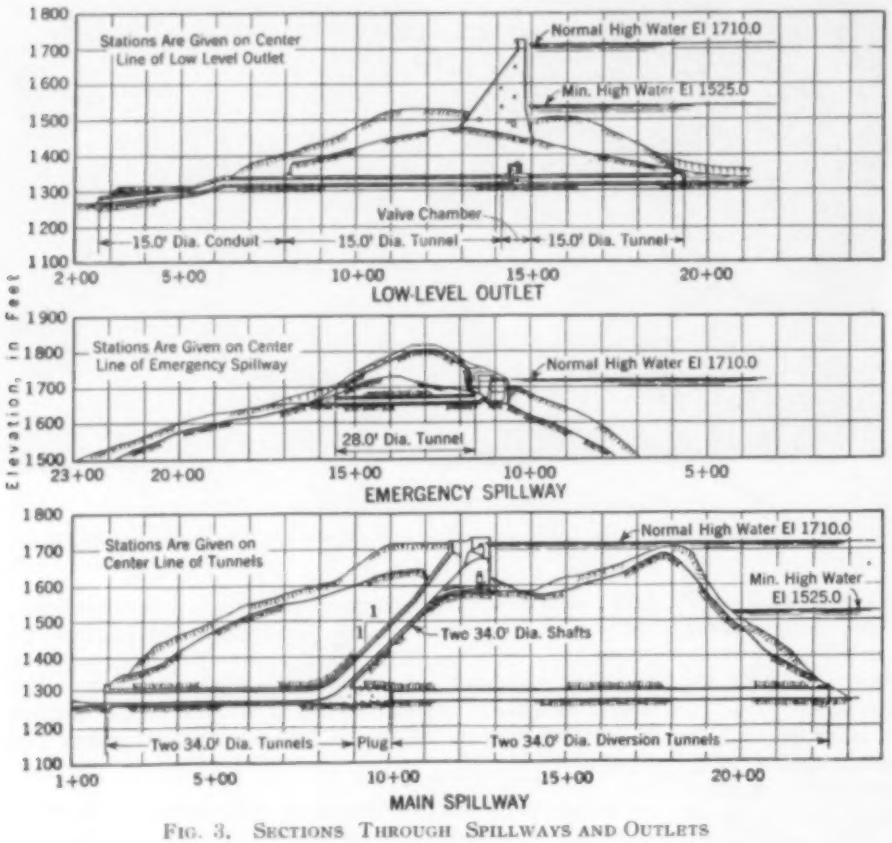

Elevation, in Feet
Stations Are Given on Center Line of Low Level Outlet
Normal High Water El 1710.0
Min. High Water El 1525.0
Valve Chamber
15.0' Dia. Conduit
15.0' Dia. Tunnel
15.0' Dia. Tunnel
LOW-LEVEL OUTLET
Stations Are Given on Center Line of Emergency Spillway
Normal High Water El 1710.0
28.0' Dia. Tunnel
EMERGENCY SPILLWAY
Stations Are Given on Center Line of Tunnels
Normal High Water El 1710.0
Min. High Water El 1525.0
Two 34.0' Dia. Shafts
Two 34.0' Dia. Tunnels
Plug
Two 34.0' Dia. Diversion Tunnels
MAIN SPILLWAY

FIG. 3. SECTIONS THROUGH SPILLWAYS AND OUTLETS

For each tunnel the maximum design flow is 95,000 cu ft per sec; the gross head is over 400 ft. The energy dissipation below the downstream portals presented a special problem. After a number of different approaches had been tried out in the Hydraulic Laboratory, the most economical and most satisfactory solution was found by building a bucket about 75 ft long, which is shaped so as to deflect the discharge upward into the air and at the same time divert it toward the middle of the river channel. The jet so formed is wide and very long, and where it hits the river channel the scouring, according to laboratory tests, is very moderate.

LOW-LEVEL OUTLET PERFORMS SEVERAL FUNCTIONS

Several functions are performed by the low-level outlet at El. 1338. Final closure of the dam is accomplished by placing concrete plugs in the diversion tunnels just upstream from their junction with the spillway shafts. This work is done behind temporary closures effected at the upstream portals of the tunnels. The maximum head that may develop on these temporary closures will be substantially reduced by release through the low-level outlet. During this closure and initial filling period, the outlet may release water to augment river flow for power that may be demanded from plants downstream. After initial filling, the outlet will supplement the reservoir control provided in the main spillway. Finally, if for any reason it ever becomes desirable to empty the reservoir, such a step will be feasible during periods of low flow.

The low-level outlet utilizes the tunnel built to bypass railroad and truck traffic around the main construction site. The tunnel was originally built in horseshoe shape just large enough to provide railroad clearances. For its hydraulic function it will be lined with concrete over the full length to a 15-ft diameter. Below the heel of the dam, a plug will be inserted with one 5-ft 8-in. by 10-ft opening through the plug. A hydraulically operated sliding gate will act as an emergency closure, while an 84-in. Howell Bunger valve mounted on the downstream face of the plug will allow regulation of discharges up to 5,000 cu ft per sec. Immediately downstream from the Howell-Bunger valve is an energy dissipator developed in the Hydraulic Laboratory. The high velocity discharge from the valve will be reduced to a velocity of 30 to 40 ft per sec. The conduit downstream from the dissipator will be only partly full for all discharges. It will lead the water to a final dissipating structure at the edge of the present river channel.

While the hydraulic computations and model tests indicate that the main spillway could accommodate the required discharge for the maximum assumed flood, there is some doubt about the conformity of the laboratory test results with prototype performance because aeration in the model is not representative of the prototype performance. To be definitely on the conservative side, an emergency spillway with a fixed crest 184 ft long at El. 715 is to be provided. A small arch dam forms the overflow crest for this spillway, which is located about 600 ft from the west abutment of the dam. A cushion pool is provided immediately back of the arch dam, and the discharge is carried through the ridge by a short concrete-lined tunnel to a secondary valley which joins the main river a half mile below the dam.

POWER INSTALLATION

At Fontana the power installation will consist of three turbines rated at 91,500 hp, each under a 330-ft head at 150 rpm. Two of these units are being installed initially, while the third will be deferred.

The relationship between dam, power station, and switchyard is shown in Fig. 1. The power station is immediately downstream from the main dam, the substructure being separated by a longitudinal contraction joint. The unit spacing of 56 ft allows the use of 50-ft dam blocks without causing too great eccentricty of the intakes in the blocks. The resulting narrow tailrace is close to the left bank of the river, leaving enough room between the channel and the canyon wall for the switchyard and access road without the use of tailrace retaining walls.

Adjustments to accommodate the reservoir are slight in comparison with those required for developments in the main valley. About 28 miles of secondary and tertiary roads must be built. However, there is one large construction job to be carried out in the reservoir resulting from partial inundation of the Asheville-to-Murphy line of the Southern Railway system. Fifteen miles of railroad will have to be built in extremely rugged territory, requiring about 2,800,000 cu yd of earth and rock excavation.

Fontana Dam was authorized by Congress in January 1942, and according to present schedules, closure will be effected in the spring of 1944, with commercial operation of the units some time in the same year. By June 15, 1943, about 350,000 cu yd of concrete had been placed.

Submerged Shipways with Steel Sheeting Walls

ON planning for the construction of twin submerged shipways—practically dry docks—for building vessels of the largest size, the Dravo Corporation found an opportunity to introduce several innovations. For example, the cellular walls of a proposed cofferdam were redesigned to become the permanent walls of the shipway. So that the ships can be constructed on an even keel, the floors of the ways were made horizontal. In the process of construction several unusual soil conditions were encountered. The sand-pile method of consolidating marl fill proved most successful. This symposium by Mr. Ackerman and Mr. Jensen was presented originally before the Construction Division at the Society's Annual Meeting in New York. Two previous articles in this series appeared in the May and June issues.

Planning the Shipways

By ADOLPH J. ACKERMAN, M. AM. SOC. C.E.

DIRECTOR OF ENGINEERING (AND PLANT EXPANSION), DRAVO CORPORATION, PITTSBURGH, PA.

LATE in 1940, the Contracting Division of Dravo Corporation had an opportunity to plan and construct shipbuilding facilities which have further advanced the mass production of smaller ships and the faster building of the largest ships. In this case, a southern shipyard wanted to expand its yard by constructing two inclined ways identical to its two largest ways, for building the largest type of combat ship. These existing ways are of the semi-submerged type with their outboard ends extending about 20 ft below sea level. They are equipped with floating caisson gates which are removed in preparation for launching after the lower end of the ways has been flooded.

It was proposed to locate the new ways in an area which was then under water to a considerable depth. The original plan was to unwater the area after driving a cellular sheet-pile cofferdam around it, and then to build the shipways in the dry. Local and geological conditions indicated that cellular cofferdam walls could be constructed, except possibly at the extreme outboard end. However, upon further study the suggestion was made that the cells be so arranged that they would remain permanently in place and serve as the walls of the full-length submerged shipways. As Figs. 1 and 2 show, the three lines of cells and connecting walls at the inboard end form two basins, one 950 ft long and 130 ft wide, and the other 1,000 ft long and 142 ft wide. At the outboard end, massive concrete gate structures were built within box cofferdams. The floating caisson gates were also erected within these cofferdams. The areas between the parallel walls were excavated to a uniform depth, and later covered with a 6-ft thickness of tremie concrete and 2 ft of finish concrete to secure a 35-ft finished depth of basin for the smaller one, and a 43-ft depth for the larger one. Weep holes were installed throughout the floor areas to prevent uplift pressures on the floor slabs. Owing to the type of dense marl on which these floors rest, leakage through the weep holes is remarkably low.

In many respects this is a novel and unprecedented type of structure, and it took considerable courage to approve the design and win its acceptance by the shipyard management. The following are some of the arguments which persuaded the shipyard to adopt the proposed scheme:

1. The totally submerged shipways would permit building ships on a level keel. This greatly simplifies framing and assembly, and eliminates the complex measurements required in allowing for an incline.

2. Horizontal keel construction would require less bolting and bracing to hold pre-assemblies and parts in place during fitting and tacking.

3. It is possible to reach a higher stage of completion before launching, since this design combines the facilities of shipways and outfitting docks.

4. No special structural details are required within the ship to take care of launching stresses.

5. It is estimated that about 10% in cost and 10% in time can be saved in the construction of airplane carriers.

6. The launching is a simple operation of flooding the basin and floating out the ship. All hazards are eliminated and important savings are gained. (About $200,000 in launching expense is required for large ships on inclined ways.)

7. There was a fair prospect that the entire project could be built in less time, and put into use at an earlier date; since the cellular walls would be part of the permanent structure instead of a temporary element.

8. The large basins permit multiple construction of a number of smaller ships.

9. The fully submerged shipways could be constructed at only a moderate increase in cost over the semi-submerged ways.

10. The basins would serve as graving docks for anything up to the largest type of vessel.

It is interesting to note that while these shipways are in every respect the same as graving docks, the disposition was not to apply this name because of the higher cost usually associated with conventional graving docks;

SHIP CONSTRUCTION BEGAN IMMEDIATELY UPON COMPLETION OF WAYS
Gate Structure at Far End

therefore they were consistently called "submerged shipways." It was possible to build these shipways at only a moderate increase in cost over that for inclined ways because the geological conditions made it possible to employ this particular design. It can be applied even more favorably where there is a rock surface at about the level of the proposed shipway floor.

SHIPBUILDING METHODS IN THE NEW WAYS

Some outstanding records were made in 1942 in constructing six ships at a time in one of these basins. Ample space and platen area is provided on each side of the shipways, together with railroad service and gantry cranes for building large pre-assemblies. Special shipbuilding cranes lift the preassemblies from the platens directly into the ships. For efficient operation these cranes must provide two special features—first, exceptional capacity and reach, and second, exceptional stability in operation and close adjustment of boom so that heavy and bulky pieces can be placed without impact or damage to the contact surfaces.

SHIPWAY CRANE WITH SCREW LUFFING MECHANISM

These needs led to the development of a screw luffing crane, the novel feature of which is a heavy triangular boom raised and lowered by a screw mounted at the rear. For safety, the design is such that the boom cannot drop even though the screw should break in two. Fourteen of these cranes, each with a capacity of 28 tons at 86 ft and 10 tons at 150 ft, were constructed. In addition, there are two cranes with a capacity of 84 net tons at 104 ft; these employ two screws each for the luffing system. All these cranes have performed with remarkable stability and safety. They represent a new development in shipyard practice to meet the demands of modern preassembly methods.

[*In the preparation of Fig. 1 in Mr. Ackerman's article in the June issue, an error occurred in the cross hatching. The only buildings that were in the original yard were the structural shop and adjacent buildings, the small warehouse, the weld-wire storage house, and a section of the machine shop. All the buildings in the east yard were part of the expansion program.*]

Constructing the Shipways

By C. B. JANSEN, M. AM. SOC. C.E.

MANAGER, GENERAL CONSTRUCTION DEPARTMENT, DRAVO CORPORATION, PITTSBURGH, PA.

CONSTRUCTION of the twin submerged shipways was primarily a problem of utilizing existing conditions and materials to the best advantage for the speedy completion of the work. The site available was in tidewater, approximately 5 ft deep at the shallow or shore end, and 15 ft deep at the outboard end. Preliminary borings indicated a considerable layer of black silty mud overlying a very dense hard marl. The marl had been exposed for many years in the immediate vicinity, remaining unwatered to a considerable depth with no lateral support and no sign of failure. It was consequently decided that this marl would provide an excellent foundation for the shipways and that steel sheet piling driven into it would cut off the flow of any appreciable volume of water. Further, in view of the very successful use of this marl in the same yard as stable foundation material, it was determined to utilize it as filling material for the cells, especially as it was necessary to excavate from the site much more than would be required to fill the cells. Sand and gravel filling, ordinarily preferable for this type of work, was not readily obtainable.

Inasmuch as the work area was entirely under water, floating derrick boats, mixer boats, and barges were provided as construction equipment. The first operation consisted of driving test steel sheet piling at intervals around the outer periphery of the work and along the center wall before the sheeting was ordered. This gave the first real information as to the unusual conditions at the site. Driving of the test piling to a reasonable bearing at approximately 20 blows per foot, with a single-acting steam hammer, 5,000-lb ram (15,000 ft-lb per

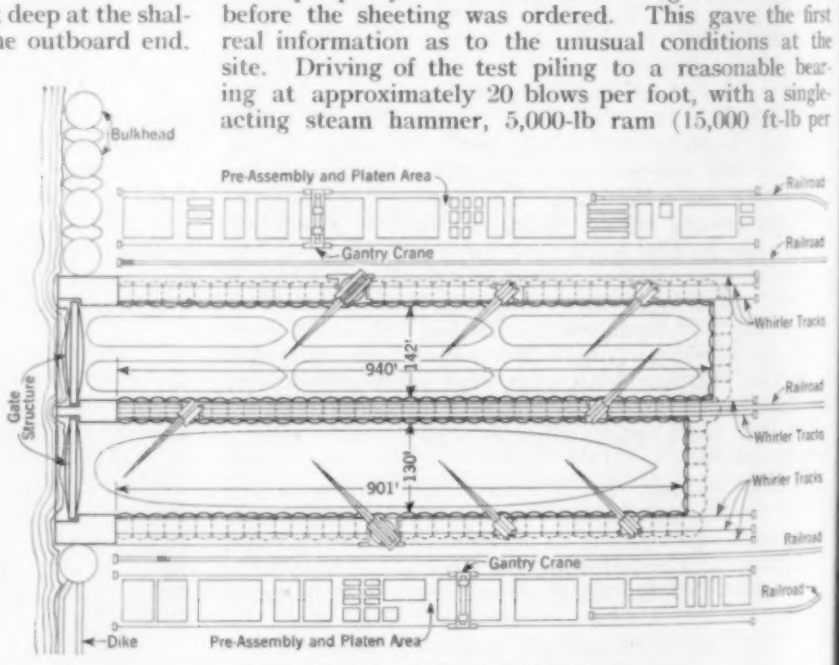


FIG. 1. PLAN OF SUBMERGED SHIPWAYS

blow) indicated the necessity of ordering sheeting ranging in length from 56 ft at the inboard or shallow end to 100 ft at the outboard end.

A 16-in. hydraulic dredge under a separate contract excavated the site for the cellular walls down to good marl wherever possible, and generally to the proposed top of the shipway floor, or 35 ft below high tide. This eliminated unnecessary driving of the sheeting with consequent possible damage to interlocks and driving out of the groove. The dredge also removed mud and silt from the interior area, leaving as much marl as possible for the filling of the cells.

The steel sheeting, of straight web type, with a web $^1/_2$ in. thick, was carefully inspected in the mill, in anticipation of relatively hard usage. Cells were of the crosswall type, generally 24 ft 4 in. from center to center of cross walls, 33 ft 10 in. from center to center of Y-pile, and 41 ft in over-all length, face to face of "arcs." The tops of the sheeting were driven to 1 ft above normal high tide —or were cut off at that level in the case of refusal. Templates were used for the accurate setting and alining of the cells, and a constant check was maintained by instrument during the driving, which went on three shifts daily and seven days per week. Cells were completely set before any appreciable amount of driving was started, and no sheet pile was driven more than 4 ft in advance of the adjacent one at any time, and usually less, to prevent driving out of the groove.

WORK PROGRESSING ON SECOND WAY AFTER DEWATERING OF FIRST
Finish Floor Concrete Has Been Poured in First Way

CELLS FILLED WITH MARL

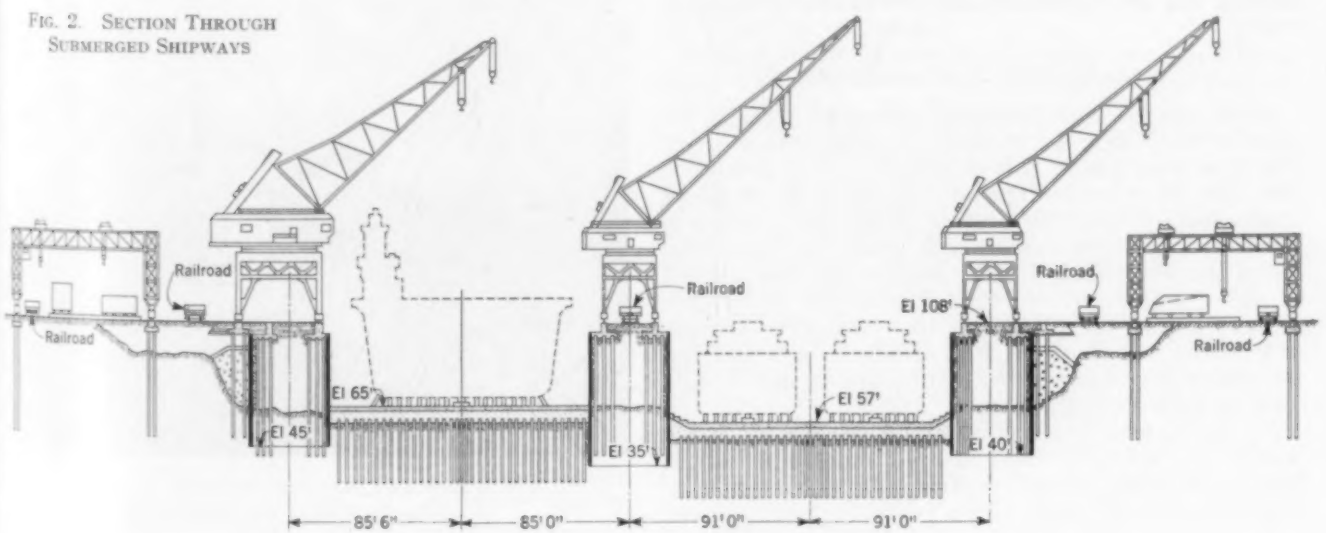
Filling the cells was started as soon as driving had progressed a sufficient distance. However, the fill in any one cell was not permitted to rise more than 10 ft above the fill in the adjacent cell, to prevent bulging of cross walls. The firm marl was excavated by a heavy-duty dredging clamshell bucket operated from a derrick boat, and was either deposited directly in the cells or rehandled by barge and again by clamshell.

In its undisturbed state, the marl appeared to be a sandy, yet highly cohesive material of a greenish color, containing a great number of white shell fragments. Atterberg-limit tests and mechanical analyses were conducted later in the program under the direction of Dr. Karl Terzaghi, M. Am. Soc. C.E., who was called in as consultant when the behavior of this marl became a problem. These tests indicated that, quoting Dr. Terzaghi, "this marl is a silty sand whose grains are composed of tough clusters of silt and clay particles. Mechanical analysis merely separates the clusters from each other without breaking them up into their individual grains. On the other hand, when the marl is thoroughly remolded in preparation for the Atterberg-limit tests, the composite grains are destroyed and the marl assumes the properties of a calcareous clay. . . . All these findings demonstrate that the marl is a rather unique material which cannot be judged on the basis of past experience with the common type of silty sands or clays."

The marl came out in chunks ranging in size up to a maximum of probably 1 cu yd. In the process of handling and depositing under water in the cells, the chunks were partially broken up, resulting in a sufficient amount of fines to fill the voids between chunks, but of soft and unstable consistency. As the top of the fill came above water level, the excess of soft or "soupy" material was flushed overboard. However, it was evident that some consolidation might be required before the cells took their final load.

After the driving and filling of the cells, walls of reinforced concrete for the crane runways were cast in

FIG. 2. SECTION THROUGH SUBMERGED SHIPWAYS



PLACING SUBMARINE CONCRETE WITH STEEL SHEETING IN PLACE TO FORM TEMPORARY BULKHEAD

All the Area in Foreground and to the Right Will Be Filled In

place, supported by timber piling driven through the fill material into the original undisturbed marl beneath the cells. These walls, with struts and fill material between, extended above the top of the steel pile structure to 8 ft above high tide. Meanwhile excavation inside the two shipways was carried to a maximum of 50 ft below high tide. The final leveling and cleaning out were done by clamshell, with some assistance from the hydraulic dredge. Material deemed unsuitable for fill was disposed of away from the site.

Timber foundation piles 35 ft long—and in the outer end somewhat longer—were driven over the entire shipway area by a floating driver with a submarine pile hammer and extension leads. These piles were so located as to provide support at the principal points of line loading. In one shipway 5,232 piles were driven, and in the other 7,516 piles. The tops of all the piles were notched and encased in the concrete floor to assist in preventing uplift. The piles were located by means of wires stretched across the shipway, and a float with range markers. Production progressed at the average rate of seven piles per hour.

Placing of the submarine concrete seal about 6.5 ft thick followed closely behind the driving of the foundation piling. The seal was poured in 48-ft monoliths extending the full width of the shipway. Cross bulkheads or "forms" consisted of arch-web steel sheet piling set on line at the advance edge of each pour. The weight of the sheeting provided sufficient penetration into the bottom, between the rows of wood piling, to take the pressure of the concrete. The top of the bulkhead was braced to floating timber trusses spanning the width of the shipway and lashed to the sheet-pile cells at both ends.

PIPES RELIEVE UPLIFT PRESSURE

Relief pipes 4 in. in diameter, extending through the concrete slab, were set securely into the bottom marl. The pipes were spaced 12 ft on centers 4 ft out from each wall, and 22 ft on centers, on lines across the shipways approximately 48 ft on centers. Each pipe was provided with a sleeve roughly 2 ft above the theoretical top of the seal, with a 4-in. removable riser pipe carried to above water level for installation and to provide support during the placing of the submarine concrete seal. After the concrete had attained its initial set, the riser pipes were removed by uncoupling and were reused for each successive pour.

Submarine concrete was mixed on the floating mixer boat, equipped with two 2-cu yd non-tilting mixers having all-electric drives. A steam whirler fed aggregate from barges to the bins, and a portable cement blower handled bulk cement from a barge alongside. A floating derrick boat placed the concrete by means of a 2-cu yd submarine bucket equipped with canvas flaps, and having relief holes in the sides under the bottom doors, and an automatic trip for single-line operation. A 6-in. slump was used to provide proper "flowability" of the concrete when placed. One sack of cement per cubic yard was added to the standard $1:2^1/_2:4$ mix for concrete placed in the dry, to compensate for loss of cement and the relative wetness of the mix in the submarine method. Random core borings taken of this submarine concrete after the shipways were pumped out, tested 3,000 lb per sq in. or better.

The submarine pours were approximately 1,200 cu yd each. Continuous care was necessary to eliminate cold joints and to hold the top of the seal within reasonable limits. The steel sheet pile bulkheads were pulled and moved ahead promptly after the concrete had attained proper set. It is especially important to note that excavation, pile driving, and concreting followed closely in sequence behind the setting, driving, and filling of the cellular walls, with no delay in any one operation while waiting for the completion of another.

At the outer end of each shipway, a floating steel caisson gate was installed of dimensions sufficient to span the entire width of the shipway and carry the full head of water at the maximum possible tide level. Consequently the outermost 80 ft of each of the three walls was constructed of solid concrete, rather than of steel sheet pile cells, to provide the necessary mass and strength for the extremely heavy loads to be imposed. Granite sills were installed at points of horizontal and vertical contact between the caisson gate and the concrete walls to minimize spalling. The center wall contained the permanent pumps for dewatering the two shipways and the flooding ducts for filling them.

It was decided to rush the construction and installation of the gates so that they could be used as a cofferdam for the initial dewatering of the shipways after sealing. Consequently a gate-structure cofferdam was constructed which was not only highly satisfactory for the placing of the concrete of the gate structure but also for the erection of the caisson gate in place.

These two cofferdams consisted of master beams of 36-in. I-beams riveted to every fourth steel sheet pile, braced at the top by a single set of steel wales and struts, at the bottom by penetration below the bottom of

GATE STRUCTURE COFFERDAM AND GATE IN PLACE

Special 36-In. Beams Are 108 Ft Long

excavation prior to unwatering, and during and after unwatering by the submarine seal concrete. Both beams and sheeting were eventually burned off under water at sill level.

STEEL PILING FOR GATE STRUCTURE

Because of the very unsatisfactory character of the material at the outer end of the shipways, it was necessary to go to a considerable depth for an adequate foundation. In fact some of the master beams with intermediate and attached sheeting were 108 ft long. At the deepest portion of the cofferdams these beams had a span of 46 ft from the top of the seal concrete to the center of the single bracing set approximately at water level. Special 350-lb 36-in. I-beams were rolled for the purpose, but it was still necessary to weld-splice two sections to get the required length of 108 ft, as the mill could not roll this length in such a size. Master beams were set and driven with extreme care in steel guide frames or spacers. The intermediate sheeting was set and driven after the master beams had been driven to grade.

Prior to the cofferdam installation, the site was excavated to 35 ft below water to eliminate all mud load. After closure of the cofferdam, excavation was carried down further to provide for a submarine seal of concrete approximately 10 ft thick. Wood supporting piles were driven by submarine hammer and swinging leads. Relief pipes were placed as a precaution against hydrostatic uplift. The submarine seal was placed by a 10-in. tremie pipe, the depth of concrete making this method permissible. Concrete was allowed to set for seven days and the cofferdam was then pumped out. Remarkably little leakage resulted.

Thereafter, the program inside the gate structure was quite simple, involving only the routine forming and placing of concrete, setting of granite sills, and erection of the caisson gate. To provide sufficient erection clearance this was erected 8 ft out from its final location, full height, and when it neared completion was jacked over to place with its rubber seal against the granite seat. The gate-structure cofferdam was then flooded on both sides of the caisson gate. As the shipway proper was pumped out, the water between the caisson gate and the inside wall of the cofferdam was drained out.

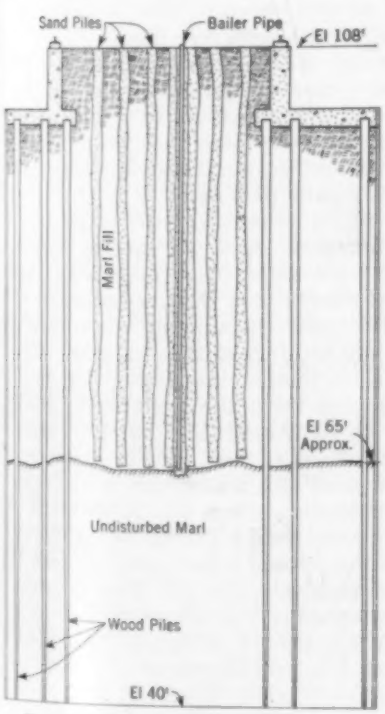


FIG. 3. SECTION THROUGH A CELL SHOWING SAND PILES

Dewatering was a relatively simple task. The 15-in. vertical pump was operated only part time to lower the water at a speed which caution dictated. The line on the shipway walls and the readings of piezometer gages were closely observed. Drain holes were burned through the inner wall of the steel sheeting as the water level dropped, to eliminate any trapped water inside the cells. Mud and laitance were bailed out with clamshell buckets and washed to the pumps. High spots of the seal concrete were cut off with pneumatic paving breakers, and mud seams were cleaned out as soon as unwatering was completed.

PLACING FINISH FLOOR CONCRETE IN SECOND SHIPWAY
Shipway Cranes Already in Place at Left

A leveling course of concrete about 2 ft thick was then placed in the dry. Concrete between the shipway walls and the drains was placed as promptly as possible to provide additional support for the side walls. Relief pipes were extended up to the top of the floor and properly capped and connected to lateral drains carried to the longitudinal main drains. The finish course was placed by temporary whirler cranes mounted on top of the shipway walls, taking the concrete from the mixer boat and handling it direct to place in 2-cu yd bottom-dump buckets. All concrete placed in the dry was internally vibrated.

Immediately behind the placing of the leveling course came the installation of service pipes for compressed air, fresh and salt water. Walkways and ramps of structural steel framing and timber surface were constructed, with expanded metal stapled to the ramps to provide foot traction and prevent slipping. Exposed faces of steel sheeting were thoroughly washed down preliminary to the application of a rust preventative. The master beams and sheeting outside the caisson gates were burned off by a diver with a submarine cutting torch. Pumphouse equipment, controls, and superstructure were completed, and the entire structure was put in condition for immediate operation.

During the progress of construction, two major problems developed which were unexpected and required prompt solution. The first had to do with the depth of suitable foundation material at the outer end of the shipway. This was fortunately subject to a simple solution. It was merely necessary to increase the length of the steel sheeting, master beams, and wood foundation piling, to meet the situation. Some additional excavation in the gate-structure cofferdams was required to reach stable material, and consequently an additional amount of submarine sealing concrete.

The second problem had to do with the unstable condition of the marl during the early stages as a filling material in the steel-pile cells. The first concern arose with the placing of hydraulic fill outside the cellular walls shortly after they were filled. This fill consisted of relatively unstable silt and clay. Before the fill reached the ultimate level of 8 ft above water level, the cellular wall deflected inward a maximum of 3 in. at the point of

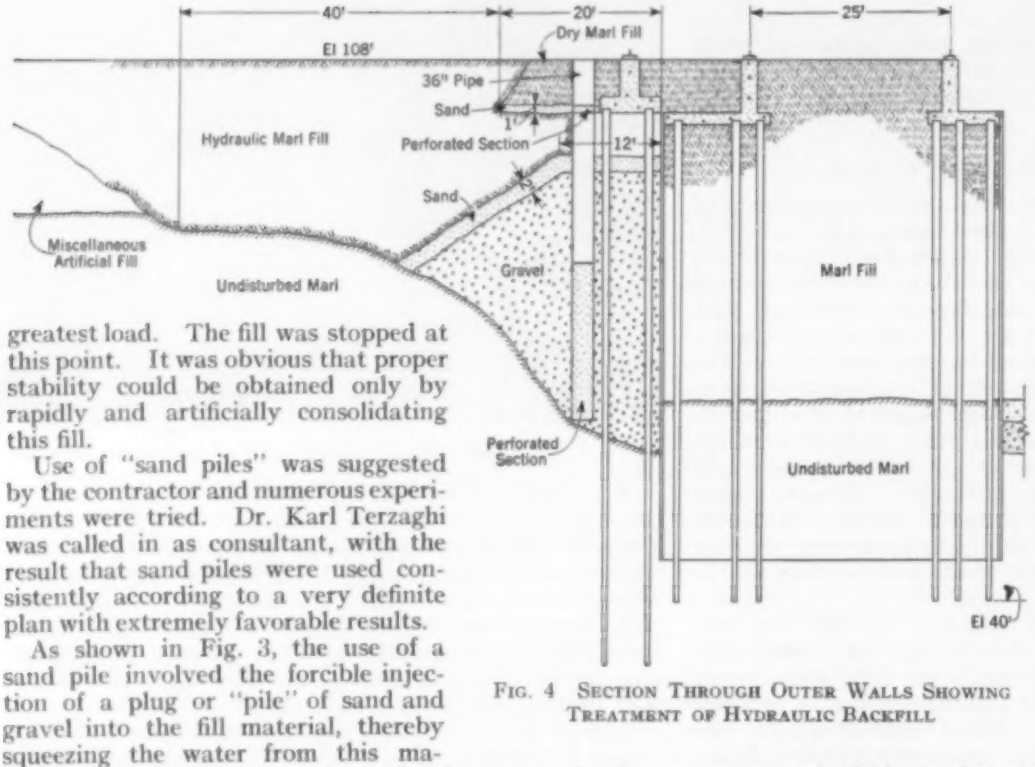


FIG. 4 SECTION THROUGH OUTER WALLS SHOWING TREATMENT OF HYDRAULIC BACKFILL

greatest load. The fill was stopped at this point. It was obvious that proper stability could be obtained only by rapidly and artificially consolidating this fill.

Use of "sand piles" was suggested by the contractor and numerous experiments were tried. Dr. Karl Terzaghi was called in as consultant, with the result that sand piles were used consistently according to a very definite plan with extremely favorable results.

As shown in Fig. 3, the use of a sand pile involved the forcible injection of a plug or "pile" of sand and gravel into the fill material, thereby squeezing the water from this material and providing a passage for its removal. To insert the plug, a pipe 12 in. in diameter, with a removable bottom plate, was driven full depth into the cell, displacing an equal volume of fill material. The pipe was then filled with a mixture of 85% of clean gravel and 15% of sand by weight, so proportioned by running it through the mixer batching plant. With the pipe full, the top was capped air-tight. Compressed air at about 20-lb pressure was introduced into the pipe, and the pipe was then slowly withdrawn. The compressed air prevented the marl from pressing out part of the sand and gravel fill as the pipe was withdrawn. The bottom plate was of course lost in each case, but it was of very slight value.

ARRANGEMENT OF SAND PILES

The first sand pile driven in each cell was centered in the cell. A 4-in. pipe with slotted bottom was inserted in the 12-in. pipe prior to filling between the two with the sand and gravel mixture. When the 12-in. pipe was withdrawn, the 4-in. "bailer" pipe remained in this central sand pile, extending the full depth of the cell, to provide for the manual removal of water as it was squeezed from the marl fill by the driving of the additional sand piles.

After the driving of the central sand pile, with bailer pipe, additional sand piles (without bailer pipes) were driven in circles about the central pipe. The water squeezed to the bailer pipe was removed at frequent intervals to keep the level in the bailer pipe at an elevation at least 25 ft below tide level. The number of sand piles driven per cell was determined by the "cut-and-try" method, based on the number of blows per foot required to drive the last sand pile in the cell. This generally resulted in the driving of from 25 to 40 sand piles in each cell.

The resulting consolidation of the fill provided sufficient stability to carry the necessary loads. To facilitate the continued drainage of the cells and consequent improvement in stability, horizontal drain pipes were driven from the interior of the shipway after dewatering through the inner row of sheeting in each cell into the central sand pile, thus permitting drainage into the shipway proper. These drain pipes are equipped with check valves at the discharge end.

TREATMENT OF HYDRAULIC FILL

It was also considered necessary to minimize the unexpectedly high pressure of the hydraulic fill which caused the deflection of the cells mentioned previously. According to the plan developed by Dr. Terzaghi, the silt and mud pumped in originally outside the cellular walls for lack of more suitable material were removed down to the level of the shipway floors (Fig. 4). A triangular section of coarse gravel, of 2-in. to 6-in. size, was deposited along the entire wall, and four drainage wells 3 ft in diameter were extended to the bottom of this fill. The top of the fill was carried to 10 ft below high tide, and the entire surface of the gravel was blanketed with approximately 2 ft of sand to exclude any possibility of mud reaching the voids in the gravel. Hydraulic fill of the best possible marl available was then pumped in as a blanket over the sand and was carried to just above high tide level. After this, the 3-ft drainage wells were pumped out, relieving the lateral pressure on the cellular walls. This pumping was continued regularly thereafter. This same drainage and relieving system was installed on the opposite side of the other shipway with extremely satisfactory results.

Soil and ground-water conditions were determined by the installation of numerous piezometer pipes, observation shafts for visual determination, "tell-tale" pipes 6 in. in diameter to determine the ground-water level, and by many line and grade studies to check the movement of the cellular walls and floors.

Although the marl filling as such did add a problem of considerable magnitude to the construction end of the job, it is evident from a chemical analysis of this material that it should have a very definite tendency to increase the life of the steel sheet piling many times that normally to be expected in a salt water area. The entire project was an extremely interesting one both from the construction and from the engineering point of view. The result to date indicates that it is completely successful. The test of any project is success or failure in operation, and this innovation in the construction of submerged shipways has proved its merit.

The submerged shipways were a project of the Navy Bureau of Ships under the general supervision of Admiral O. L. Cox. The men responsible for the shipways were M. M. FitzHugh, representing the shipyard, and J. S. Miller, vice-president in charge of contracting work for the Dravo Corporation, who conceived and directed the design and construction. Karl Terzaghi, M. Am. Soc. C.E., was consulting engineer to the Dravo Corporation.

Preparing for Public Works in the Post War Period

Abstracted from an Address Presented Before the Metropolitan Section of the Society

By FRANK W. HERRING, M. AM. SOC. C.E.

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WHEN the war ends, new jobs must be found for at least one out of every four men and women that comprise our war working force and our armed services. Also when the war ends, we are going to need those types of public improvements that can be provided only through construction operations. The prospect of these two probable post-war conditions —widespread unemployment and a great need for public construction—has led many to arrive at the easy conclusion: "Employ all of the unemployed on public construction. The post-war goal of full employment can thereby be achieved at once." This conclusion overlooks these salient factors in the situation:

First of all, the responsibility for providing post-war jobs certainly is not a government monopoly. To be sure we the people, through our government, want to assure freedom from want to our fellow citizens. But this does not necessarily imply that government alone must provide work opportunities.

Second, a proposal to employ all the otherwise unemployed on public construction assumes that we shall need public facilities more than we need other goods and services. To give public construction activities a disproportionate share of our national effort in the post-war period would mean that we should suffer for the lack of the other goods and services that we shall need equally as much, if not more.

Third, we are going to need those facilities produced by public construction operations after the war whether there is an unemployment situation or not. Our need for public works will not be determined by the number of unemployed and the duration of their unemployment.

Fourth, post-war public construction programs cannot be brought into existence by touching a button or waving a wand. Authorizations must be obtained, engineering plans and designs and specifications must be prepared, and sites acquired, all before one shovel of earth can be turned in actual construction operations.

Fifth, and finally, our construction resources are not unlimited. Nor is it likely that they can be mobilized at a post-war rate that will be fast enough to provide employment opportunities to keep abreast of the demobilization of our war workers and armed forces.

ACHIEVING FREEDOM FROM WANT

Returning to the first factor, freedom from want cannot be achieved without full employment and a recognition of our collective responsibility to the less fortunate of our fellow men who are unable to work because of ill health or old age.

This post-war task of achieving full employment is a fourfold one:

First, the healthy and aggressive development of private enterprise must be encouraged, for upon it rests the major responsibility for assuring that opportunities for earning a living will be available.

Second, our expenditures on the maintenance and increase of our physical assets—our houses, our commercial buildings, our roads, our streets, our schools —must be kept in balance with our voluntary savings as a nation. The government can aid in maintaining this balance by providing those types of common facilities and improvements—those "public works"— which encourage and induce private investment. For example, a post-war nation-wide airport program would encourage civilian flying and thus expanded investments in airplane manufacturing and servicing facilities.

Third, we must assure the distribution of the goods and services that we produce. We can produce the goods—that is no longer a problem—but our exchange mechanism has frequently fallen far behind. If we are to have full employment, the exchange of the goods and services that are produced must take place continuously.

Fourth—and finally—we may conceivably find that even if we have done all these things, the goal of full employment may still not have been reached. There may be periods of adjustment, such as will follow the end of the war, when workers may be unemployed through no fault of their own. During such temporary periods the government must assure the exchange process through unemployment compensation, and aid in maintaining the savings-investment balance by expanding those construction and improvement activities which will, in turn, induce more private investment. And, as engineers know, the expansion of public construction and improvement activities cannot be achieved rapidly at such a time without the previous preparation of detailed plans and blue prints for the works and structures to be built.

Taking the second factor—that of the size of a public construction program—with reasonably full employment and a national post-war income of 110 billion dollars a year (in terms of pre-war prices) it is probable that we could afford to spend about 14 billions annually on all construction, without unduly interfering with our demands for other goods and forces.

PUBLIC CONSTRUCTION ALONE INSUFFICIENT

This does not mean, however, that we could spend 14 billion dollars for public construction alone. The main point is that when the war ends, even with our goal of full employment and a national income of 110 billions, public construction cannot have an exclusive claim on our construction resources—our construction labor, materials, and equipment. For example, we shall need houses no less than we shall need highways. To give one a disproportionate share of our national construction effort would mean that we would suffer for the lack of the other.

Upon the basis of our past experience with a national income of 110 billion dollars and a construction volume of about 14 billion, I anticipate that we could afford to spend between 4 and 5 billion dollars annually for the facilities we normally think of as public construction.

The third factor in the post-war situation is the tendency to calculate the need for public construction

in terms of the number of unemployed and the probable duration of their unemployment. If we made such a determination during the war, for example, the result would be that having no unemployment we would need no public works. The opposite, is, of course, the truth. We need certain public facilities now more than we have ever needed them before.

It is time for us to recognize clearly that our post-war public construction programs will be, in reality, merely the post-war version of our regular public construction program, rather than a special-purpose program for solving unemployment.

The fourth factor is the crucial importance of being ready to resume our public construction operations when the war ends. Many preparatory steps must be taken before a project can actually be got under way, and it is necessary that we understand fully the character and extent of those preparations.

The most obvious step necessary is the preparation of detailed plans and specifications. Experience indicates that the cost of such preparation normally runs about 4% of the construction cost. Therefore, the cost of planning each billion dollars' worth of proposed post-war public construction should average about 40 million dollars. Moreover, we may estimate that the technical manpower requirements for such preparation will be about 10,000 man-years. If, for example, at the end of the first post-war year we wish our public construction activities to be operating at a level of 4 billion dollars a year, we should spend in plan preparation probably not less than $160,000,000. Furthermore, the technical manpower requirements for such preparation would be about 40,000 man-years.

MORE PREPARATION NEEDED

We are now prepared to begin construction on short notice on a volume of federal projects which would call for but 600 million of construction volume during the first twelve months of the post-war period. The situation in connection with state and local government projects is not accurately known. It is not supposed, however, that there are now enough fully prepared to raise the 600 million dollars to more than 1.5 billion dollars. But the completion of plans and specifications alone will not assure that public construction activities can be got under way quickly in the post-war period. These administrative steps preparatory to construction are of particular importance in connection with those projects which are to be undertaken by local government agencies: (1) authorization of the project, (2) appropriation of funds for land acquisition, (3) land acquisition itself (possibly including condemnation), (4) appropriation of funds for detailed plan preparation, (5) the technical work of preparing plans and specifications, and (6) authorization of whatever bond issues are involved in the financing of construction. The last step may include local referenda.

The fifth and last factor in our post-war situation involves the maximum rate at which we might expect to increase our public construction activities from the low level that will probably prevail before the war ends.

Some evidence on the rate that can be expected is given by experience during the war period, particularly that of 1940 and 1941. The increases in construction activity during those years represent the greatest rate of increase that the country has ever seen. On the basis of that experience, it appears that the maximum annual rate of increase we might expect would be about 3.8 billion dollars, or an average annual increase of 760,000 men employed on construction.

Thus, the maximum volume of 14 billion dollars annually would not be reached until the fourth post-war year. This volume of 14 billions annually assumes that the average annual on-site employment can be sustained at 2,800,000 men, slightly in excess of the previous peak in August 1941. In addition, such a construction volume would also provide employment for another 4,200,000 persons in the production of construction materials, machinery, and equipment. At this maximum volume of 14 billion dollars annually, I estimate that what we now regard as public construction would be 4 to 5 billion dollars annually.

If these estimates are correct, the employment opportunities to be provided by public construction during the first two or three years after the war appear indeed somewhat slim in relation to the probable size of the unemployment problem. It is clear therefore that public construction activities alone do not hold the key to our post-war unemployment problem. A five-way approach to the problem is proposed.

First, we must try to key the demobilization of our war activities to accord with the creation of post-war job possibilities. We must have a demobilization plan with a time table—the orderly transition from war to peace cannot be accomplished without such a scheme.

READJUSTMENT OF SOCIAL SECURITY

A second approach lies in the readjustment of our social security legislation, particularly those laws dealing with unemployment compensation. As the National Resources Planning Board put it in its recent report, there should be a "reorganization of the unemployment compensation laws to provide a broadened coverage, more nearly adequate payments, incorporating benefits to dependents, payments of benefits for at least 26 weeks, and replacement of the present federal-state system by a wholly federal administrative organization and a single national fund."

Such an extension of the unemployment compensation system would allow some leeway in our demobilization plans, and would also permit workers to move to other areas where employment opportunities were developing.

The third approach lies in a large deferred repair and maintenance program of both private and public operations, of brief duration, perhaps of not more than 18 months, and specifically limited to small jobs. This program could be started rapidly throughout the country and would give temporary employment to demobilized construction workers while the volume of new construction was built up. Coupled with this program there should be another one of dismantling the surplus military and naval installations in the country—or converting them to a peacetime use.

Fourth, a broad program of non-structural improvements to our national estate—our lands and forests—is proposed. This would mean the establishment of work relief and training camps for the purpose of undertaking the manifold tasks involved in protecting the soil and forest resources of the nation.

And finally, of course, it is proposed that construction operations, both private and public, be pushed as rapidly as possible. Let us not forget that every time we put a hundred thousand men to work in construction under regular standards for hours and wages, we put 150,000 other men to work in the factories, mines, and forests. If we can reach the goal of 2,800,000 men employed in construction by the fourth year after the war, we shall be employing 4,200,000 more "behind the lines." Seven million men at decent jobs and regular wages is by no means a small contribution to full employment.

The Design of Shasta Dam

Part II. Overflow and Non-Overflow Sections, Joints, and Cooling System

By KENNETH B. KEENER, M. AM. SOC. C.E.
DESIGNING ENGINEER ON DAMS, U.S. BUREAU OF RECLAMATION, DENVER, COLO.

EACH feature in the design of a structure as immense as Shasta Dam demands assiduous study; at the same time all the features must be considered together to assure efficient operation. The most appropriate type of dam having been decided upon (see Part I in the June issue of CIVIL ENGINEERING), it then became necessary to determine such fundamental characteristics of the structure as cross-sectional dimensions and structural requirements for flood control.

TO draw off the heat generated by the six million cubic yards of concrete in Shasta Dam, about nine million feet of cooling coils were placed. Besides a description of this cooling system, Mr. Keener explains the design of the overflow and non-overflow sections, and the "block" method used in placing the concrete. This is the second article in his series on Shasta Dam. Such a careful record of an outstanding engineering feat adds to the store of knowledge available to designing engineers.

Following the usual method for the design of concrete gravity dams, trial sections were sketched for both the overflow and the non-overflow portions. These sections were analyzed to determine whether factors of safety were adequate. To save time, the proportions of trial sections were based largely on the results of analyses of other dams with similar physical characteristics. Where the conditions were not comparable, a proportional modification of the lines was made. The sections determined and used in the specifications drawings (Fig. 1) give an 0.8:1 slope for the downstream face.

In the abutment section, this slope extends down to foundation contact, and in the spillway section, down to the curved transition leading to the spillway apron. For both sections, the upstream face is vertical down to a point 357½ ft below the top of the dam, where the slope changes to 0.4:1, which continues to the foundation.

SPECIAL DESIGN ASSUMPTIONS

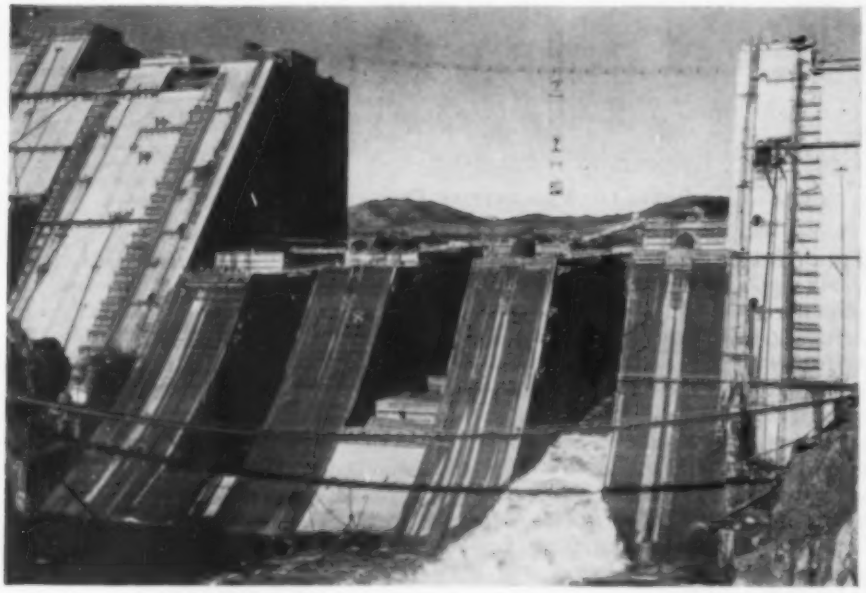
The basic assumptions of design used in the analyses of the sections appeared in the TRANSACTIONS of the Society ("Basic Design Assumptions," by Ivan E. Houk and Kenneth B. Keener, Members Am. Soc. C.E., Vol. 106, 1941, page 1115), and thus are not included in this article. However, a few of the special assumptions and applicable constants which may be of particular interest are listed, as follows:

1. All resistance to loading is dependent upon gravity action entirely. The effects of arch action and twist action between adjacent vertical cantilevers are negligible and were not considered.
2. There is no silt load.
3. Uplift pressure, on the base or horizontal sections, varies from full reservoir pressure at the upstream face to zero or tailwater pressure at the downstream face, as the case may be, and is effective over two-thirds of the area of the base or horizontal sections. Uplift pressure is not affected by earthquake shock.
4. The horizontal and vertical components of an assumed earthquake shock have an acceleration equal to 0.1 that of gravity, and a vibration period of 1 sec. The horizontal component has a direction of vibration normal to the axis of the dam.
5. Between the upstream and downstream faces of the section of dam analyzed, vertical stresses have a linear variation.
6. Under normal conditions, with the reservoir full, the difference between reservoir and tailwater surfaces is 480 ft.
7. Unit weight of concrete is 154 lb per cu ft.
8. Ultimate shear resistance of both concrete and rock is 600 lb per sq in.
9. Coefficient of internal friction of concrete or concrete on rock is 0.65.

UPSTREAM FACE OF DAM IN COMPRESSION

Overflow and non-overflow sections were analyzed for conditions existing both when the reservoir is full and when it is empty, each with and without earthquake effects. In all analyses of the overflow section, the effects of the spillway apron were included in computing the stability factors. Stress conditions were analyzed at six vertical planes through the abutment section, at eight vertical planes through the spillway section, and at five distributed elevations common to both cross

DIVISION OF DAM INTO BLOCKS DURING CONSTRUCTION



LOWER TIER OF RIVER OUTLETS UNDER CONSTRUCTION

sections, as well as at one additional elevation in each section which was not common to both. The additional elevation for the abutment section was 52½ ft below the top of the dam and 75 ft above the highest elevation common to both sections. Corresponding closely with the deepest excavation expected, the additional elevation for the spillway section was 557½ ft below the floor of the spillway bridge and 65 ft below the lowest elevation common to both sections.

The results of these investigations determined designs that were used in the specifications. For both sections, with the reservoir full or empty and without any consideration of earthquake effects, results showed that the upstream face was entirely in compression. Moreover, at full reservoir, the compressive stress at any point was always greater than the water pressure at the corresponding point. The maximum compressive stress was 474 lb per sq in. and occurred at the heel of the spillway section for the condition of empty reservoir. For the condition of full reservoir, the downstream faces also were entirely in compression, but for an empty reservoir the non-overflow section was subject to slight tension although the spillway section was entirely in compression. The maximum compressive stress was 539 lb per sq in., and the maximum horizontal shear stress was 249 lb per sq in. Both stresses occurred at the toe of the spillway section for the full-reservoir condition.

Without earthquake effects, the maximum sliding factor was 0.595 for the non-overflow section and 0.613 for the spillway section, and both occurred at the same elevation, 345 ft below the full-reservoir water surface. The minimum shear-friction factor was 6.6 for the non-overflow section and 6.8 for the spillway section, each at the base of the section in question.

With earthquake acceleration acting horizontally upstream and vertically upward, the maximum compressive stress of 744 lb per sq in. occurred at the intersection of the downstream face and the base of the spillway section, with a full reservoir. At the same location and under the same conditions, the maximum horizontal shear stress was 349 lb per sq in. The maximum tensile stress of 84 lb per sq in. occurred at the downstream face of the non-overflow section, 135 ft above the base, with empty reservoir and earthquake acceleration acting horizontally downstream and vertically upward.

After specification designs were made, the slope of the inclined portion of the upstream face of the dam was changed from 0.4:1 to 0.5:1 to improve the stability conditions. This change, however, affected the stress results only slightly. Also, since the contract designs were prepared, the spillway section has been analyzed on the basis of non-linear distribution of stresses along the horizontal planes. The results, while of considerable interest when compared with those for linear-stress distribution, did not indicate the desirability of modifying the designs.

BLOCK SYSTEM AND COOLING SYSTEM

At Shasta Dam the conditions were similar to those at two previous Bureau of Reclamation dams, which had resulted in the adoption of the "block system" of placing concrete. Approximately 6,100,000 cu yd of concrete were to be placed in about four years' time in a monolithic high-head hydraulic structure. Excluding the spillway apron, the base width of this structure would be about 560 ft, or nearly equal to the height of the dam. If the concrete were placed in a single mass between two forms built from abutment to abutment, outlining the upstream and downstream faces only, numerous interconnecting cracks would develop similar to those in the natural foundation, if not worse. As is well known, this cracking of a large mass of concrete is due to volume changes induced principally by temperature variations.

Let us consider how these changes would affect the 2,860-ft concrete portion of Shasta Dam under normal conditions, without any preventive measures. Concrete placed at an average temperature of 70 F would soon attain a temperature of 105 F because of the heat of hydration of the setting cement. Eventually, under natural conditions, the temperature of the mass would drop to an average of 55 F. Thus there would be a maximum reduction in temperature of 50 F, with a consequent reduction in volume. Under these conditions, if a single transverse crack were formed, it would be 9½ in. wide, using a coefficient of contraction of 0.0000055. Actually, because of restraint developed largely by foundation contact, a single crack would not be formed, but instead there would be numerous irregular transverse cracks, aggregating a total width of 9½ in., and it follows that if these cracks were spaced 50 ft apart, each would have a width of well over ⅛ in.

In a similar manner, longitudinal or circumferential cracking would occur, on account of the great thickness of the dam, and this, from the point of view of safety,

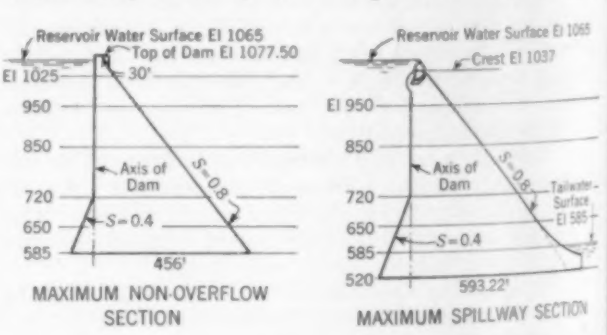


FIG. 1. TYPICAL SECTIONS THROUGH SHASTA DAM

would be more serious than the transverse cracking. Transverse cracking would result in direct leakage and a leaching action on the soluble compounds of the concrete, but longitudinal cracking would destroy the shear strength of the structure and permit the building up of dangerous hydraulic heads within the body of the dam—all conditions that would nullify the assumed load conditions for which the dam was designed.

CONTRACTION JOINTS PROVIDED

As in the case of other mass concrete dams, this inevitable cracking under normal conditions was anticipated and provision was made for it by the use of contraction joints. Prevention of such cracking can be attained by controlling the location, width, and even the time of opening of these predetermined joints so that they can be readily and thoroughly sealed at the proper time.

Provisions were made in the design, for construction with vertical transverse and longitudinal formed surfaces, spaced generally about 50 ft apart, thus subdividing the dam into 50 by 50-ft blocks or columns, each separated from adjacent columns by joints which could open as the contraction of the concrete progressed. A photograph shows the arrangement of the block system. (Also see Figs. 3 and 4 of Part I, June issue.) Longitudinal joints are staggered where they cross the transverse joints and are provided with horizontal keyways, whereas the transverse joints are designed with continuous vertical keyways. All contraction joints are provided with metal sealing strips that cross the joints near the faces of the dam and near the foundation contact, as well as at several intermediate locations, subdividing the entire joint system into zones. A metal-pipe and outlet-box grouting system was designed to be imbedded in the concrete. Neat-cement grout will be pumped under pressure into the various zones after volume change in the concrete columns has resulted in the maximum opening of the joints.

In a structure as large as Shasta Dam, many decades would elapse before the concrete would reach its final temperature. There are definite disadvantages in letting it cool naturally. During the winter months, high temperature differences between the exposed surfaces and the center of the mass would result in high stresses tending to produce cracking. Moreover, the opening of contraction joints would be delayed so long that the joints could not be sealed with grout before the reservoir would have to be filled; and after it was filled, such grouting would be difficult.

As a consequence, specifications required a complete cooling plant to remove heat by the circulation of river or refrigerated water through tubing embedded in the concrete. Approximately 9,000,000 lin ft of 1-in. outside-diameter metal tubing was designed to be placed on the tops of the 5-ft lifts (see photograph). The tubing

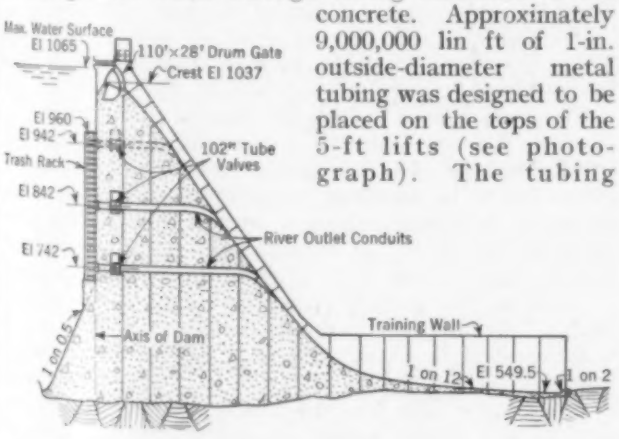


FIG. 2. SPILLWAY SECTION SHOWING OUTLET CONDUITS

INSTALLING COOLING PIPE ON TOP OF A 5-FT LIFT OF CONCRETE

extends, generally, in an upstream-downstream direction and crosses the longitudinal joints, but does not, as a rule, cross the transverse joints. It is placed in coils averaging about 800 ft in developed length, and spaced about 5 ft horizontally throughout the greater part of the dam. Temperature was required to be reduced progressively during the construction period to about that which eventually would be reached by natural processes. Surfaces exposed to the atmosphere permanently or for long periods of time, were required to be cooled to 60 F, since the mean annual air temperature for the locality is about 61.4 F. In the lower part of the dam, where a large surface would be exposed to the cold reservoir water, the temperature was required to be reduced to 48 F. Plans did not provide, however, for artificially cooling the thin portion near the top of the dam.

SPILLWAY CAPACITY DETERMINED

Hydrological studies, based on the recorded peak floods of the Sacramento River, had established that the upper 500,000 acre-ft of water in the reservoir was to be devoted to flood-control purposes. This determination and the consideration of the characteristics of the watershed indicated that the required total capacity of both spillway and outlet works, at full-reservoir head, should amount to 250,000 cu ft per sec. An additional requirement, developed from studies, was the need for a total combined capacity for flood-control spillway and outlet works of 100,000 cu ft per sec, exclusive of power-penstock requirements, when the head was 17 ft less than that of full reservoir. Thus, after deducting outlet-conduit capacities from these total capacities, the spillway crest was designed for a capacity of 187,000 cu ft per sec at a full-reservoir water-surface elevation of 1,065, and for a capacity of 45,000 cu ft per sec at a reservoir water-surface elevation of 1,048. (A view of a model of the spillway appeared in Part I, June issue.)

To regulate the flow into the spillway, as well as the water-surface elevation of the reservoir between certain elevations, the floating type of drum gate was selected. These gates will be described in a subsequent article.

Shasta Dam, as designed and being constructed, is the highest overflow-type dam in the world. The maximum drop down the face to normal tailwater will be 480 ft. As a result of such a fall, with the spillway-capacity discharge of 187,000 cu ft per sec and no discharge from the outlets, the total energy concentrated at the bottom of the sheet of falling water will amount to about 7,200,000 hp or 19,200 hp per lin ft of spillway width. The importance of dissipating this energy created near the toe

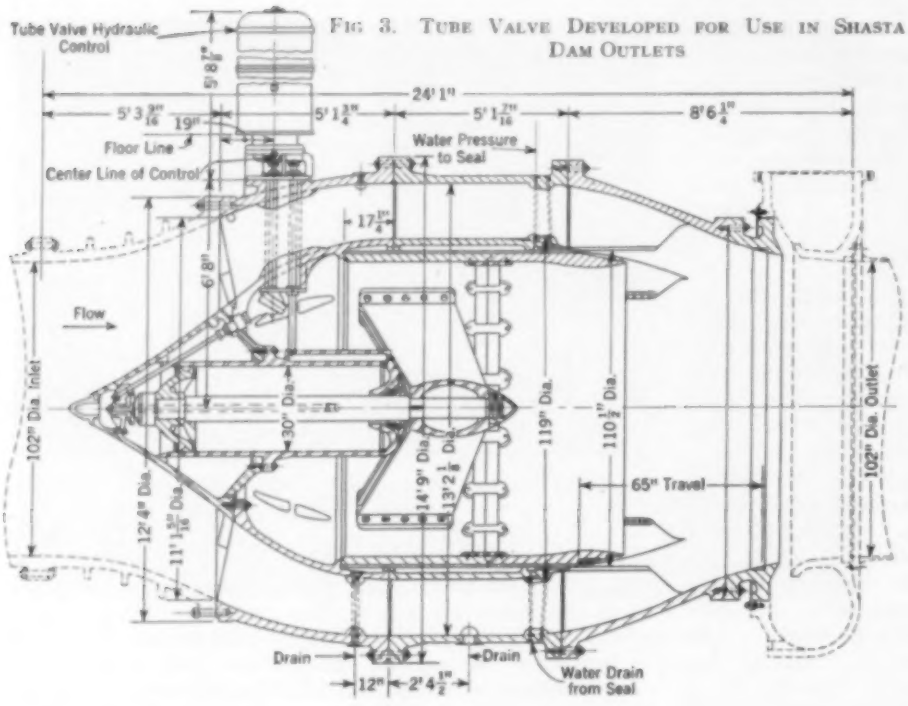


FIG. 3. TUBE VALVE DEVELOPED FOR USE IN SHASTA DAM OUTLETS

of the dam so that no damage might result cannot be minimized. To prevent damage, this great dissipation of energy will be accomplished by deflecting the flow from the steep downstream face by a compound vertical curve onto a relatively long concrete hydraulic-jump apron with the greater portion of its surface 25 ft below the river-bed level. (Figure 2 shows a typical cross section of the spillway and apron.)

Spillway flow and that from the outlets through the overflow section of the dam will be confined to the 375-ft width of spillway by two concrete training walls that will extend down the face of the dam, around the deflection curve, and to the end of the apron. Plans include an elevated lip at the termination of the apron which, together with the proper gradient and dimensions of channel, will result in a hydraulic jump within the reach of the channel for any discharge up to the maximum spillway capacity. In preparing plans, hydraulic model studies were used in the determination of the proper form of spillway channel and in checking design computations.

OUTLET REQUIREMENTS FOR MISCELLANEOUS USES

Requirements for certain combined discharges of the spillway and outlets already have been discussed in connection with the spillway. In addition to those requirements, studies of project demands for irrigation, navigation, and other uses indicated that for a reservoir water-surface elevation of 860 ft, at which point the storage will be 750,000 acre-ft, the outlet capacity should be 15,000 cu ft per sec exclusive of the capacity required for power generation. Also, it was desirable that the total outlet discharge be controlled closely.

To meet these two conditions when construction designs were prepared, three 102-in. diameter outlets, the lowest in the dam, were provided at center-line elevation 736.67 through the spillway section of the dam; and two 86-in. diameter pipes at center-line elevation 789.08 through the right abutment section, and were extended from the dam to discharge into the power-plant tailrace. Close control of flow through the latter was to be accomplished by the installation of 60-in. diameter needle valves in their outlet ends, and 86-in. diameter high-pressure ring-seal gates were to be installed near the inlet ends for emergency closure. To accommodate the other draft requirements at higher reservoir levels, three 102-in. diameter outlets at center-line elevation 836.67 and seven at elevation 936.67 were provided through the spillway section. Ring-seal gates were to be located a short distance from the upstream face of the dam in all outlet conduits through the spillway section to control the flow, and for emergency closure these were to be in tandem for the two lower tiers of conduits.

This scheme for adequately meeting the outlet requirements has been described principally, because of its inclusion in the specification drawings. However, it has been discarded in favor of another which more economically fulfills the same requirements and also is better from the standpoint of operation, a change made possible largely by the recent development of the tube valve by the Bureau of Reclamation. This valve is a modification of the needle valve and, like it, can be operated at partial openings under high heads. Among its advantages, when compared with the needle valve, are cheapness because of fewer parts, with a consequent decreased cost of installation, and the fact that its mechanism is less subject to hydraulic vibrations. (Figure 3 shows an assembly of a Shasta Dam tube valve.)

In contrast to the original scheme, the present and final plan for the outlet works at Shasta Dam provides that all 102-in. diameter conduits will pass through the spillway section, thus dissipating the energy of the outflow on the spillway apron. These conduits will be lined with plate steel and placed horizontally, except for short reaches at their downstream ends, which will be curved and formed to simulate the trajectory of a jet of falling water. To eliminate negative pressure and hence reduce the danger of cavitation of the steel lining, the curved ends will be constricted gradually in the direction of flow. The conduits, totaling 18, will be arranged in tiers, four at center-line elevation 742 (see photograph), eight at 842, and six at 942. Flow through each conduit will be regulated by a single high-pressure hydraulically operated tube valve installed in the conduit line a short distance from the upstream face of the dam. Intakes of all outlet conduits will be protected by semicircular reinforced-concrete and steel trashrack structures built onto the upstream face of the dam up to El. 960.

Elimination from the original designs of the emergency gates in the two lower tiers of conduits necessitated a substitute for this desirable feature. Accordingly, guides are to be provided in the intake structures of all conduits to accommodate a coaster gate. This gate consists, principally, of an unhoused gate leaf equipped with an endless roller train at each side, and it is operated by cable from a gantry crane traveling on the spillway bridge. To provide this means for operating the gate, it was necessary to change the shape of the spillway crest from the section shown in Fig. 1 to that shown in Fig. 2. The crane also provides a way for moving the one gate to any outlet intake for unwatering purposes as occasion demands.

Flow Diversion at Niagara Falls

I. History of Power Development and Scenic Exploitation

By NORMAN MARR

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DIVERSION of Niagara River water around the Falls for the generation of hydroelectric power has long been regulated so as to safeguard the view which has drawn honeymooners from around the world. The international character of the problem led to the creation of a Special International Niagara Board which recommended the remedial works recently undertaken to readjust the flow between the Canadian and the American Falls. This paper, which Mr. Marr presented at the Niagara Falls Meeting of the Society, held jointly with the Engineering Institute of Canada, gives the interesting background of the new project.

THE Falls of Niagara, together with the cascades and rapids above and the whirlpool and rapids in the lower river, constitute one of the outstanding and best known scenic spectacles of the world. Throughout the years countless millions of people have been drawn to Niagara to view the majesty of the Falls and the grandeur of the cascades and rapids. The same conditions that combine to create this scenic spectacle provide an enormous power potentiality. This is not far short of 6,000,000 continuous horsepower if the mean flow of the river could be utilized for the development of power through the total head of 310 ft. This head is made up of the 55 ft of fall in the mile of rapids above the Falls, the 160 ft in the sheer descent of the Falls themselves, and the 95 ft in the six miles of rapids below.

In the latter part of the nineteenth century, conditions in the vicinity of Niagara had reached a deplorable state. Government reservations had not yet been made on either side, and the exploitation of the grandeur of the Falls for private gain had proceeded to such an extent that it was said no view of the Falls could be had from a foot of United States soil without paying for the privilege. Conditions were little better on the Canadian side. Industrial enterprise, too, had been allowed to establish itself on shores and islands in a manner most detrimental to the scenic effect.

In 1878, the State of New York and the Province of Ontario appointed commissions to acquire lands on both sides of the river for the purpose of establishing park reservations and restoring, as far as possible, the natural beauties of the area. The splendid results achieved by the commissions are to be seen today in the treatment of the foreshores of the river and of the islands in the American Channel embraced in the New York State Reservation at Niagara and in the system of parks and boulevards included in the Queen Victoria Niagara Falls Park, which extends along the Canadian foreshore from Fort Erie at the head of the river to Niagara-on-the-Lake at the river's mouth.

RESTRICTION OF WATER DIVERSIONS FOR POWER DEVELOPMENT

Rapid increase in power development in the early years of the twentieth century gave promise that the Falls would be so denuded of water as greatly to detract from, or indeed possibly to nullify completely, their value as a scenic spectacle. Taking cognizance of this problem the Congress of the United States, on June 29, 1906, passed the Burton Act "For the control and regulation of the waters of Niagara River, for the preservation of Niagara Falls, and for other purposes." The Act assumed jurisdiction of the Niagara River to the international boundary line and limited the diversion of water from the Falls for power production on the United States side to the amounts required to operate the power enterprises then in use or actually under construction, with such limitation on the importation of power from Canada as would, it was then believed, equitably adjust the diversions on both sides of the river.

A few years later a treaty was concluded by His Majesty the King and the United States. Known as the Boundary Waters Treaty of 1909, it provided for the settlement of boundary waters problems between Canada and the United States. Article V dealt with diversions from the Niagara River and provided that the total withdrawal from above the Falls for power purposes was not to exceed in the aggregate a daily diversion of 56,000 cu ft per sec—20,000 cu ft per sec on the United States side and 36,000 cu ft per sec on the Canadian side. The limitations of the Boundary Waters Treaty still govern except for certain increases in diversions during the present war emergency which have been agreed upon by Canada and the United States.

POWER DEVELOPMENT

Power development on the United States side of the Niagara River is recorded as far back as 1725, when a French settler erected a water-driven sawmill at the edge of the rapids above the Falls. During the next 125 years a number of other small sawmills, grist mills, and a paper mill operated with power developed from the rapids, but it was not until 1853 that the first attempt was made to utilize the Falls themselves. After nearly twenty-five years of effort, this undertaking failed to achieve economic success. The successful exploitation of power from the Falls dates from 1877 with the initiation of development by the Niagara Falls Hydraulic Power and

CANADIAN FALLS WHEN DISCHARGE WAS 198,000 CU FT PER SEC

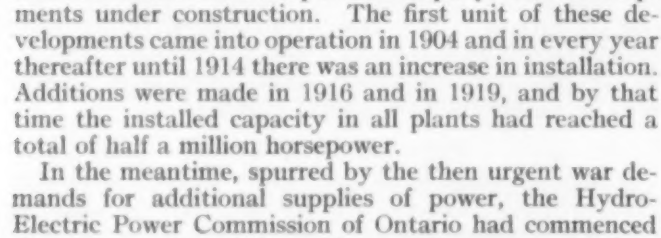
Manufacturing Company, which in addition to having its own power station, supplied water from its canal to several tenant companies.

Another company, the Niagara Falls Power Company, commenced construction operations in 1890 and in 1895 was producing power at its first development, which was completed in 1900. A second development began producing power in 1902 and was completed in 1904, by which time machinery to generate 110,500 hp had been installed in the company's two stations. In the meantime, the hydraulic company's progress was less rapid, but in various new stations and extensions a total capacity of 167,200 hp had been installed by 1914.

As the limit of permissible water diversion was being reached, and as many of the installations were using water inefficiently, it was realized that the only way in which a much-needed increment of power could be secured was by united action. This was accomplished by a consolidation, in 1918, of the existing companies into the Niagara Falls Power Company, which abandoned a number of units and used the available water in new developments designed to utilize to the maximum the power available. The result was the existing efficient station below the Falls known as the Schoellkopf Station, with an installed capacity of 452,500 hp. For standby or emergency use, the older and less efficient installation of 110,500 hp, in what is known as the Adams Station, was retained.

Power development on the Canadian side was begun in 1893 with an installation of 2,000 hp for the International Railway Company. Early in the new century, however, three companies—the Canadian Niagara Power Company (a subsidiary of the Niagara Falls Power Company), the Ontario Power Company, and the Electrical Development Company—had developments under construction. The first unit of these developments came into operation in 1904 and in every year thereafter until 1914 there was an increase in installation. Additions were made in 1916 and in 1919, and by that time the installed capacity in all plants had reached a total of half a million horsepower.

In the meantime, spurred by the then urgent war demands for additional supplies of power, the Hydro-Electric Power Commission of Ontario had commenced the construction of its Chippawa-Queenston development designed to utilize as much as possible of the entire descent between Lakes Erie and Ontario. In 1921 the first unit of this development came into operation, and in 1925 nine units had been installed with a tenth or reserve unit being added in 1930 giving the station a maximum normal plant capacity of 500,000 hp. During this period also, the Commission acquired the properties of both the Ontario and Electrical Development Companies so that it has at present, in the three stations, a combined maximum normal plant capacity of 830,000 hp. The Canadian Niagara Power Company's plant, with a normal output of 100,000 hp from an installed capacity of 121,000 hp, is the only other plant now operating on the Canadian side.



CANADIAN FALLS WHEN DISCHARGE WAS 106,000 CU FT PER SEC

The full operation of all installations on both sides of the river (Fig. 1) would require a total diversion of water in excess of the limit of 56,000 cu ft per sec imposed by the Boundary Waters Treaty of 1909. On the United States side such full operation would require the diversion of approximately 32,500 cu ft per sec, and on the Canadian side about 50,000 cu ft per sec.

PLANS FOR PRESERVATION OF THE FALLS

Because of concern regarding deterioration in scenic effects at Niagara Falls through erosion and diversion of water, a Special International Niagara Board was constituted by the two Governments of Canada and the United States early in 1926. The purpose of the Board was to conduct an extensive investigation into means of preserving the scenic beauty of the Falls, and an analysis of all related factors.

In its final report of June 22, 1928, the Board found that the scenic beauty of Niagara Falls had been adversely affected by the development of three conditions:

1. Erosion and recession of the crest line upstream.
2. Low flows in the Niagara River resulting from low cycles of levels in the Great Lakes system.
3. The withdrawal of water from the Great Lakes and the Niagara River for power, navigation, and sanitary purposes.

In regard to erosion and recession, its studies indicated that the mean rate of recession of the central part or "apex zone" of the Horseshoe Falls had been 3.8 ft per year from 1842 to 1905–1906, and 2.3 ft per year from 1905–1906 to 1927. A statement which had received wide circulation "that the Horseshoe Falls is 'committing suicide' and is in danger of destroying itself as a spectacle by cutting a narrow 'notch,' destroying the symmetry of the Horseshoe, possibly degenerating into a cascade, and eventually draining the American Falls," was found by the Board to be quite unwarranted for the following reasons:

1. For some years the recession of the crest has tended to move upstream along the course of two diverging deep-water channels on each side of a central shoal, with the result that the "toe" of the horseshoe is growing broader rather than cutting into a single "notch."
2. The floor of the upper rapids and the crest of the Falls is a very hard and thick stratum of limestone. Recession occurs through the falling of large blocks of this limestone as it is undercut through the wearing away of softer underlying strata. The thickness of this upper stratum increases from about 78 ft at the present crest line to about 130 ft at the head of the upper rapids. As the crest moves upstream, the increased thickness of this stratum will decrease the rate of recession.
3. As the Falls recede, the active part of the crest line will increase in length, and the flow per unit of crest will decrease. This natural thinning out of the flow will tend to decrease the rate of recession.
4. During recent years a large part of the flow has been diverted for power purposes. This fact has probably decreased the rate of recession.

For these reasons the Board concluded that the active part of the horseshoe will broaden out and the crest line lengthen in graceful curves and that, if adequately supplied with water, the main part of the horseshoe, 100 or 200 years hence, should present an appearance equal or

superior to that of the present. It was estimated that recession will not progress to the point of draining the American Falls for at least 2,000 years.

Recessions of the Horseshoe Falls, however, were found to have adverse effects on scenic values on the Goat Island and Canadian flanks. If left to nature the Goat Island shelf would soon be completely dry, even in high-water seasons, and would take its natural place as a part of the wall of the gorge. The same condition would take place at the Canadian flank although to a lesser degree.

The recession of the American Falls was found to be negligible as the flow over the crest had never been sufficient to cause any material wearing away of the talus at the foot of the Falls which, so long as it exists, prevents undercutting and consequent erosion.

To remedy or prevent existing or prospective impairment of the scenic beauty of the Falls, it was concluded that the flanks of the Horseshoe and the rapids immediately upstream could be reclothed with an adequate flow and kept covered for many hundreds of years by the construction of works to abstract water from the deep channels now feeding the central portion and divert it to the flanks. The rate of recession of the central portion of the Horseshoe, which was already found to be decreasing, could be further decreased in some measure by abstracting water from the central heavy flow; this recession, however, would not become an active menace to scenic effects for several hundreds of years.

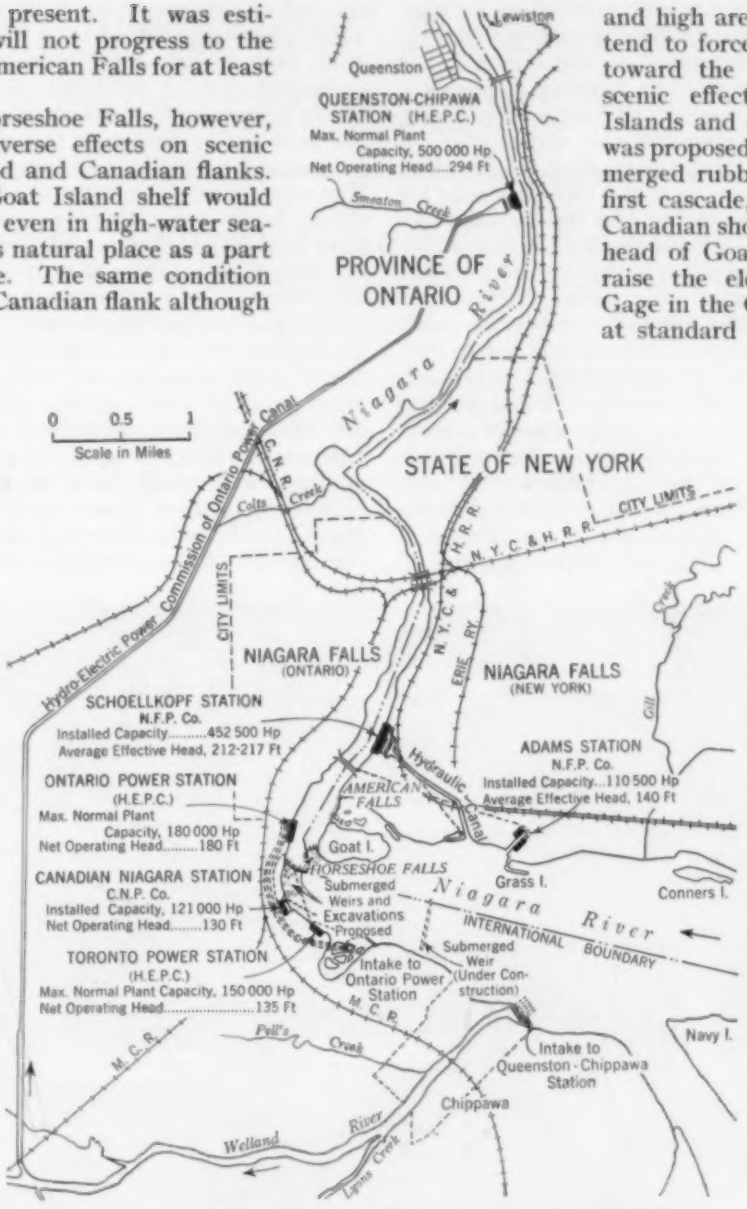


FIG. 1. POWER DEVELOPMENTS AND REMEDIAL WORKS, PROPOSED AND UNDER CONSTRUCTION, AT NIAGARA FALLS

Elaborate works designed to fix the Horseshoe in its present position were considered unnecessary. If undertaken they would be only partially successful and would probably destroy some of the present important scenic effects. The injuries to the rapids in the vicinity of Three Sisters Islands and in the American Channel and to the American and Luna Falls could be overcome by works above the first cascade, designed to raise the level of the Grass Island Pool and throw more water against the head of Goat Island and into the American Channel.

The works proposed consisted of submerged irregular weirs built from near the shores of the rapids just upstream from the flanks and extended far enough into the adjacent heavy flows, which now feed the central portion of the Horseshoe, to intercept the desired amount of water and guide it toward the flanks. The effect of the weirs would be reinforced by the excavation of such shoals and high areas near the shore as now tend to force the flows from the flanks toward the center. To restore the scenic effects at the Three Sisters Islands and at the American Falls, it was proposed to construct a deeply submerged rubble mound weir above the first cascade, extending from near the Canadian shore toward the shoal at the head of Goat Island and designed to raise the elevation at Grass Island Gage in the Grass Island Pool one foot at standard low stage and under the then existing conditions of diversion. The cost of the works was estimated at $1,750,000. It was proposed to test the efficacy of these works by the withdrawal, on a temporary basis, through power stations on both sides, of 20,000 cu ft per sec in addition to the limits imposed by the Boundary Waters Treaty of 1909.

On March 19, 1941, the Great Lakes–St. Lawrence Basin Agreement was signed at Ottawa by representatives of the Governments of the United States and Canada. This agreement was wide in scope and embraced virtually all matters related to the utilization of the water in the Great Lakes–St. Lawrence Basin. Article IX of the Agreement provided for the construction of remedial works in the Niagara River and for the immediate diversion on each side of the river of an additional 5,000 cu ft per sec of water for power purposes. Provision was also made for testing the effects of the remedial works under a wide range of conditions by a Great Lakes–St. Lawrence Basin Commission to be established by the two governments under the terms of the Agreement. Provision was also made for recommendations by the Commission respecting diversions from Lake Erie and the Niagara River.

The Great Lakes–St. Lawrence Basin Agreement has not yet been approved by either government. In the meantime, however, urgent war emergency demands in both countries for additional power in the area tributary to the Niagara River resulted in the authorization, by successive exchanges of notes between the two governments, of increased diversions for power purposes on both sides. The latest exchange of notes, that of October 27, 1941, brought the authorized diversions to virtually the maximum capacities of the existing generating plants; 32,500 cu ft per sec on the United States side and 50,000 cu ft per sec on the Canadian side. The increase on the

Canadian side includes an amount equivalent to that which is being or is shortly to be diverted by Ontario from the Albany River watershed to the Great Lakes system, an amount estimated to be 5,000 cu ft per sec.

In authorizing these temporary additional diversions, the two governments recognized the importance of undertaking immediately the construction of remedial works in the Niagara River above the Falls not only for the protection of scenic values but also for the improvement of power-producing facilities during the war emergency. In the exchange of notes it was agreed that the total cost of remedial works undertaken would be divided equally between the two governments. Also, temporary advisory committees which had been constituted by each government in October 1940, in connection with the Great Lakes–St. Lawrence Basin project, were instructed to get together for the purpose of recommending to the two governments (1) the exact nature and design of the remedial works that should be constructed in 1942, and (2) the allocation of the task of construction as between the two governments. The Committees submitted a joint report on January 23, 1942, recommending the immediate construction, at an estimated cost of $803,000, of a submerged weir in the Grass Island Pool, designed to raise the water surface in the pool one foot more or less at standard low water as envisaged by the Special International Niagara Board. The report pointed out that in addition to improving conditions for the generation of power, the construction of this weir would also improve the scenic beauty of the Falls by diverting additional water to the American Falls and over the Goat Island flank of the Horseshoe Falls.

It is not the purpose here to discuss the design of the the submerged weir or the construction methods proposed by the committees, as these are to be dealt with in other papers. It is sufficient to say that the governments accepted the joint recommendations of the committees and work is proceeding on the construction of the weir, on the American side under the direction and control of the U.S. Army Corps of Engineers and on the Canadian side by the Hydro-Electric Power Commission of Ontario under the control of the Dominion Department of Transport.

VERTICAL VIEW OF NIAGARA FALLS SHOWING LOCATION OF REMEDIAL WORKS

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Suspended Span Restrained by Friction Devices

By J. E. Tonnelier, M. Am. Soc. C.E.

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On a suspension bridge in the New York City area, the main span is secured at the towers by pin-connected links and to the lower portal strut of the bridge with a connection which is both pin-connected and sliding. This arrangement by itself would restrain the bridge deck from moving laterally and vertically but would permit it to move longitudinally under certain conditions of temperature and wind. To restrain the deck from moving under wind pressure, and at the same time to permit its movement under changes of temperature, the bridge floor was provided at each end with friction devices of sufficient capacity to stop the wind movement but not the temperature movement.

The first friction devices provided were not a success. The principle on which they were designed was adequate, but there was considerable error in the assumption of stresses to which they were subjected. The result was that in less than a year they showed signs of failure. Plans were made for installing new friction devices, and with the benefit of the previous experience it was possible to improve these in design as well as in capacity.

As the new devices had to be erected in restricted space, it was necessary to give consideration in the design to the size of the members and to the means of getting them in place. In part, the difficulty was overcome by burning away parts of the bridge members to permit the placing of the new friction members, the parts burned away being replaced by arc welding when the work was completed.

Each friction device, Fig. 1, consists of a heavy steel tongue which connects at one end to the pin that provides the lateral support for the bridge floor. The other end of the tongue passes between two steel castings supported on the portal strut, castings which provide the friction for the restraining effort. Pressure is applied to the castings by means of a system of levers and a counterweight. To limit the movement of the tongue and to force movement to take place at the opposite end of the bridge if one tongue tends to move too far, stop pieces are fastened to each tongue. As originally planned, these stop plates are placed at the points where the design showed that theoretically movement of each tongue should cease. But the actual length of the bridge floor was greater than the theoretical length by an amount that would have caused each stop plate to touch the restraining casting before the maximum temperature was reached. To prevent damage to the equipment because of this condition, the stop plates had to be moved.

In order to have the bridge under some sort of restraint at all times, the new friction device for one end was completed before the old device at the other end was removed. It was not possible to discover that the stop plates were not properly placed until the second tongue

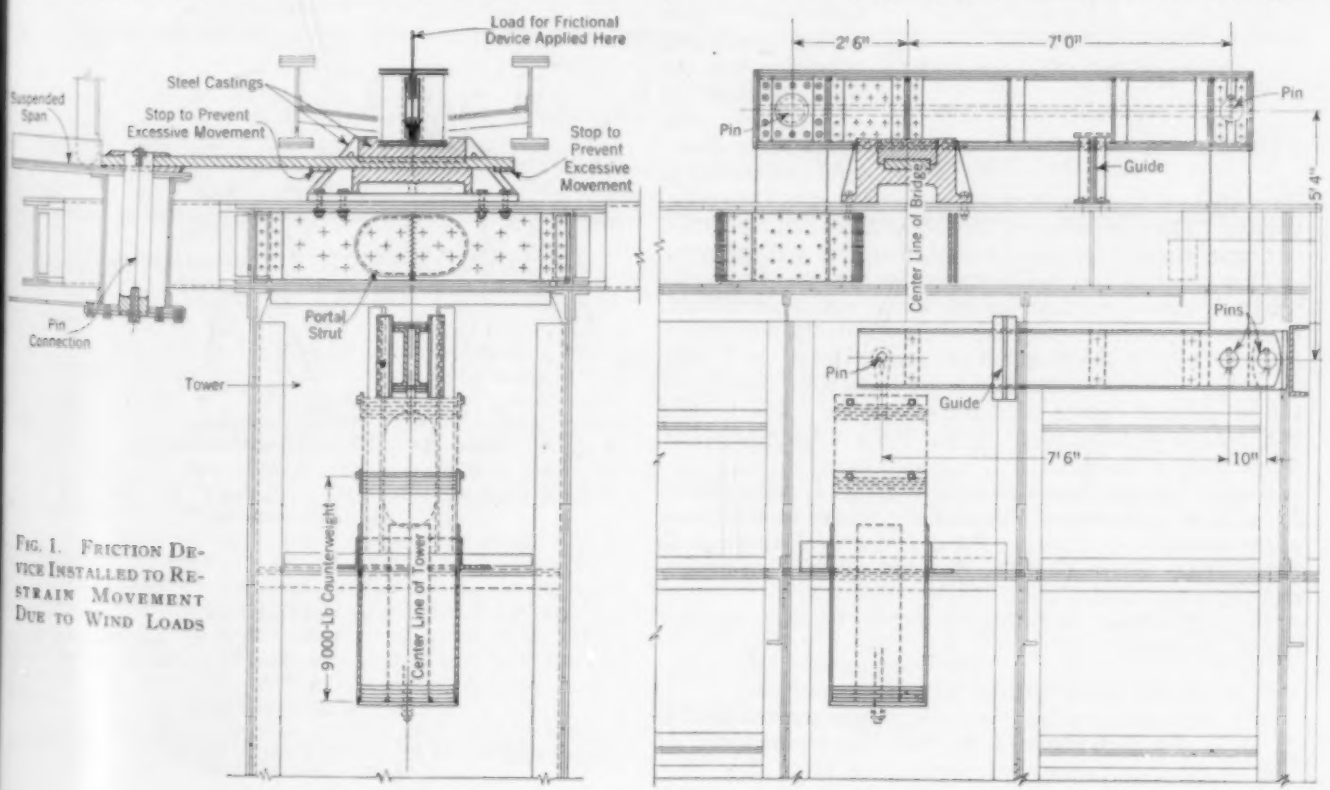


Fig. 1. Friction Device Installed to Restrain Movement Due to Wind Loads

was set, at which time all the rigging and scaffolding had been removed to the opposite end of the bridge. In order to remove and reset the stops on the first tongue without dismantling the friction device and removing the tongue, the old stops were cut off and new ones welded on. All this work was so situated that it could be done without the aid of scaffolding or rigging. Advantage was taken of the change to provide welds that would fail (as nearly as could be determined) under an ultimate stress of about 25% less than the maximum working stress in the friction tongue.

[This paper is printed by courtesy of the Lincoln Arc Welding Foundation; it formed part of a paper which received a prize in the Foundation's recent competition.

Pressures on Unsymmetrical Pile Groups

By ROBERT B. B. MOORMAN, ASSOC. M. AM. SOC. C.E.

ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF MISSOURI, COLUMBIA, MO.

A USEFUL application of a modified form of the Mohr-Land construction occurs in the case of eccentrically loaded unsymmetrical pile groups. Presented in this article is the modified form of the Mohr-Land construction together with an example showing its application to a pile group.

In the computations that follow it is assumed that the masonry base which rests on the piles is so rigid that a plane through the tops of the piles before application of the loads remains plane after their application. This leads to the assumption that the intensity of pressure on the piles varies linearly with the distance from the neutral axis. While in the example that follows all the piles are assumed to be alike, this assumption is not an essential condition in the application of the method proposed here.

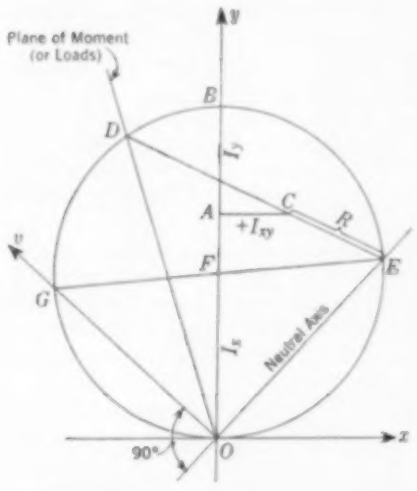


FIG. 1. MOHR-LAND CONSTRUCTION

The pressure on individual piles for a given loading condition can be determined by computing the effect of the direct load and adding to it the effect of the bending moment produced by the eccentricity. The evaluation of the latter effect can be carried out expeditiously by use of the Mohr-Land construction.

This construction is illustrated in Fig. 1. From the origin O, the intersection of the x and y axes, construct, to some convenient scale, $OA = I_x$, $AB = I_y$, and $AC = I_{xy}$, where I_x = the moment of inertia about the x axis, I_y = the moment of inertia about the y axis, and I_{xy} = the product of inertia with respect to the x and y axes. When I_{xy} is positive, plot it to the right of the y axis, and when negative to the left.

Next construct the circle shown in Fig. 1, using $OB = I_x + I_y$ as a diameter. Draw OD parallel to the plane of the moment (or loads). From D draw DE through C. Then $CE = R$ is called the directed moment of inertia and OE is the neutral axis.

The unit stress (or pressure) due to bending is $p_1 = Mv/R$, in which

p_1 = stress per unit of area (or pressure per pile)
M = moment (for loads on pile groups the moment is equal to the load, P, times the eccentricity, e)
R = directed moment of inertia (Fig. 1)
v = perpendicular distance from the neutral axis, in direction OG, as shown in Fig. 1

The total pressure on an individual pile of a pile group is equal to the pressure p_1, due to bending, plus the pressure p_2, due to direct load. The pressure p_2 may be expressed as $p_2 = P/n$, in which n = number of piles. The total pressure, p, on a pile may then be expressed as the sum of p_1 and p_2 or

$$p = p_2 + p_1 = \frac{P}{n} + \frac{Mv}{R} = \frac{P}{n} + \frac{Pev}{R}$$

To illustrate the application to an actual case, assume a pile group as shown in Fig. 2. In this case all the piles are assumed to be alike, that is, each is considered to be a unit area, and the center of gravity, moments of inertia, and product of inertia are determined on this basis. The gravity axes are shown as the x and y axes. The other computed data are as follows: $I_x = 108.9$, $I_y = 50.4$, and $I_{xy} = -21.6$. The load $P = 150$ kips is located at $x = -0.8$ ft and $y = +1.5$ ft.

Plot these data to scale and draw a circle using $I_x + I_y$ as the diameter. Show the plane of the loads by drawing a line, OD, through the center of gravity, O, and the point of application of the resultant load. From D through C

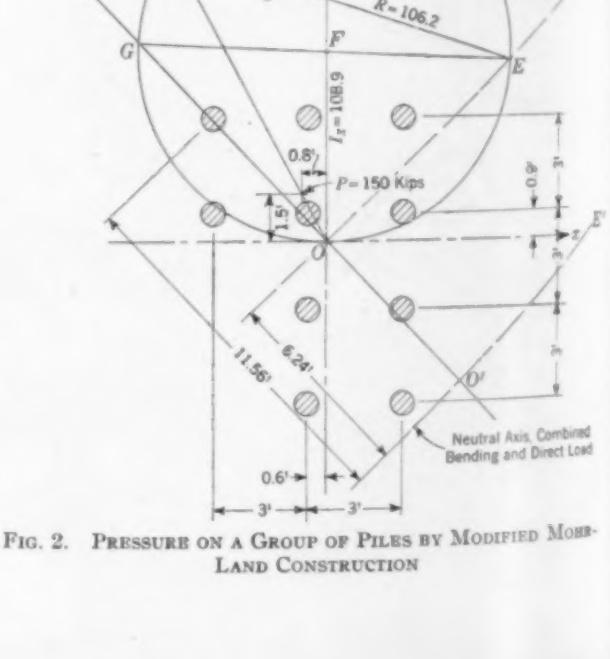


FIG. 2. PRESSURE ON A GROUP OF PILES BY MODIFIED MOHR-LAND CONSTRUCTION

draw DE. The directed moment of inertia, R, is CE and is scaled as 106.2. The neutral axis would be OE if only bending were considered. If the effect of the direct load is considered, the neutral axis is $O'E'$ at a distance $v_1 = R/ne$ from OE in the direction opposite to the load P. If $O'E'$ should fall within the pile group, it would indicate the existence of tension among the piles, but in this case it falls outside, indicating that compression exists over the whole group. Next draw the line EG through the center of the circle F, the bisector of BO. The direction in which v is measured is given by OG. The pressure on the most stressed pile may be computed as

$$p = \frac{P}{n} + \frac{Pev}{R} = \frac{150}{10} + \frac{(150)\ (1.7)\ (5.32)}{106.2} = 27.75 \text{ kips}$$

if v is measured from OE, or

$$p = \frac{Pev'}{R} = \frac{(150)\ (1.7)\ (11.56)}{106.2} = 27.75 \text{ kips}$$

if v' is measured from $O'E'$. The eccentricity, e, is computed as

$$e = \sqrt{e_x^2 + e_y^2} = \sqrt{(-0.8)^2 + (1.5)^2} = 1.7 \text{ ft.}$$

Practical Solution for Equations of Higher Powers

By CLEMENT A. DIDDEN
TIDEWATER CONSTRUCTION CORPORATION, NORFOLK, VA.

FOR several years I have used a simple method of solving equations that are of higher powers than the second. It may be quite common, but I have never seen it used elsewhere.

Let it be required to solve the following equation:

$$-\frac{x^3}{48} + 7.02x^2 - 88.56x = 47{,}000$$

Simplifying,

$$-x^3 + 336.96x^2 - 4{,}250.88x = 2{,}256{,}000 = C \ldots\ldots (1)$$

From a few quick numerical computations it will be evident that the proper value of x lies between 100 and 125. For convenience and quick results, we will make a first assumption that the value is 100. As it happens, the true value is somewhat larger, but the method is just as simple in the case that the assumed value is too high rather than too low.

If x is taken as 100, then $-x^3 + 336.96x^2 - 4{,}250.88x = 1{,}944{,}512 = C' \ldots\ldots (2)$

or $dC = C - C' = 311{,}468$.

Differentiating Eq. 1,

$$(-3x^2 + 673.92x - 4{,}250.88)dx = dC \ldots\ldots\ldots (3$$

Thus, if $x = 100$, then $33{,}141dx = dC = 311{,}468$; whence $dx = 9.4$. From this, $x = 100 + 9.4 = 109.4$

This second and closer approximation of x may be checked by substituting $x = 109.4$ in Eq. 1 as follows:

$-1{,}309{,}344 + 4{,}032{,}816 - 465{,}024 = 2{,}258{,}448$ instead of 2,256,000

The resulting error is only 0.1% and therefore negligible in a practical case; or it can be reduced by a second approximation if necessary. For example, if x were now taken as 110, the computations would still be quite simple, but the revised value of x would be much more nearly exact.

This method can be applied to equations of any power. It is more simply and easily used than many others for solving such equations.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments on Timber-Concrete Bridge Decks

TO THE EDITOR: The article on "Timber-Concrete Bridge Decks Used in Florida" by W. E. Dean, in the April issue, is a very interesting discussion of a type of short-span trestle construction that has received considerable attention in recent months because of the present shortage of critical materials. In normal times, however, in most areas where suitable structural timber is costly, the economic advantage is with the more permanent types of short-span construction, such as concrete-slab spans.

There are three points in Mr. Dean's article upon which I wish to comment.

In the first place, it is preferable to avoid vertical holes through timbers, as such points tend to be foci for early deterioration due to dampness and dry rot, if the treatment happens to be faulty. Scabs lagged to the sides of timbers are preferable to drift pins, and floors may be held down by twisted galvanized straps lagged horizontally into the laminae and the bent caps.

My second comment has to do with the jointing of the laminae in the deck. No laminae should be broken at the support, as moment and shear are both a maximum at this point, and the timber will be most efficiently employed if the full section is utilized. The stiffness of the deck will not be impaired, and there will be less tendency for dry rot in the deck and pile cap, should percolating water occur. Pieces of full-span length should be used throughout and spliced near the quarter points, staggered on alternate sides of the bent, and scattered so that not more than one-fourth of the pieces are spliced within a distance of 2 ft. Moments and consequent curvature of the floor in this region are small, so that adequate material is still furnished to resist stresses; and accurate elastic analysis can be made, as any uncertainties in the relatively small values of M/EI in this area will have little effect upon the stress distribution.

Thirdly, if old highway guard fence wire is tightly stretched over lag screws or heavy spikes, so that the slack is removed, the mesh will act as true temperature and shrinkage reinforcement. Two-ply transverse and longitudinal mesh have been used in timber-stringer spans of the conventional type with concrete floor, and the heaviest highway and military loads have been carried without difficulty.

ARNOLD STAUBACH, Assoc. M. Am. Soc. C.E.
Austin, Tex.

Need for More General Education

TO THE EDITOR: The article by John M. Hayes on "Engineering Pedagogy," in the May issue, treated a topic which must be of great interest to many engineers. In his daily work the engineer develops, to a very high degree, a functional approach towards things. The question of just how functional his college education was in preparing him for his life after graduation should be of great concern to him.

I cannot entirely agree with Mr. Hayes' emphasis on the importance of practical engineering experience as a qualification for a good engineering teacher. It by no means follows that the successful practitioner in engineering, any more than the successful practitioner in any other profession, will make the successful teacher. In common with many other engineers, Mr. Hayes lays great stress on the practical side of an engineering education. With each advance of science, new fields are constantly opening up for the engineer. The schools are trying to keep up with new developments in industry. Each year, new courses are added to the curriculum, so that the graduate may have some working knowledge of the field in which circumstances may place him. Already, the four-year course has become too short. Many engineering schools require their students to attend summer classes, and there is talk of extending the college curriculum an extra year. This would mean five years for a bachelor's degree.

Each year the trend towards specialization grows stronger. Cultural courses are dropped from the engineering student's curriculum wherever possible. The English literature course becomes "English Literature for Engineers"; the public speaking course becomes "Public Speaking for Engineers"; and the economics and foreign-language courses are similarly modified. This is contrary to Mr. Hayes' definition of the "fundamental purpose of education." If this trend towards specialization is continued to its logical conclusion, the student of the future will be trained to do a specific set of tasks as a carpenter or a mechanic is trained to do his specific set of tasks. The engineer will neither know nor care what relationship his work will bear to the welfare of society as a whole, nor will he be interested in furthering his knowledge so as to best serve his fellow men.

Education should be directed towards developing the student so that he will have a well-rounded viewpoint in later life. His technical education should be such that he will not have too great difficulty in familiarizing himself with the details and practices of the particular field he enters after graduation. It should emphasize a thorough understanding of engineering fundamentals. With such an education back of him the student will not feel lost when he enters new work. His training should be such that he will not forget it in the years after his graduation. He should realize the necessity and desirability of keeping up with new developments in his field. The engineer whose technical education rests on a firm foundation will find it far easier to familiarize himself with the procedures and practices of a new field than the engineer whose training has been highly specialized and "practical." When the "practical" engineer tries to understand a technical paper on some new theory or development, he may soon discover the inadequacies of his specialized technical education. Unfortunately, circumstances often keep the engineer from entering the field of his college specialty, and he must be qualified to hold his own wherever he may find employment.

However, the engineeer's education should also stimulate his interest in intellectual matters. Indifference to culture is only too prevalent among engineering students. As a result of this indifference, few engineers in later life become the intellectual and cultural leaders of their community. Thus the student's limited outlook impairs his usefulness to society and to his profession.

Mr. Hayes has echoed the desire of many engineers for a more practical education. However, I would ask engineers to review what effect on their professional success, or lack of success, a less "practical" and a more general education might have had.

MILTON A. KARP, Jun. Am. Soc. C.E.
New York, N.Y.

Temporary Military Roads

DEAR SIR: I had considerable practice in building temporary military roads on the Eastern front during the first World War, and I wish to emphasize some details that are sometimes overlooked. If trees, planks, and similar materials are used for fixing roads in swampy (or sandy) localities, it is better not to place the material normal to the axis of the road, but at an angle of about 60 deg to that axis. If this is done, one wheel only, rather than two at a time, will pass over a given tree. Hence, the bending moment will be smaller, and weaker material may be used. Another advantage of this method is that it affords quieter travel.

The accompanying drawings, depicting various phases of corduroy roads, are taken from the second edition of my book on highway engineering, which was published in Moscow in 1929. A cross section and plan are represented in Fig. 1, while Fig. 2 shows the details of fixing guard rails to the underlying trees. Wire may also be used in affixing the guard rails. Finally, Fig. 3 represents the situation when only rather short trees are available. In the latter case, it is advisable to make alternate joints. Obviously, trees should be arranged according to diameter, rather than placed at random, in order to create a traveling surface without jumps.

D. P. KRYNINE, M. Am. Soc. C.E.
Research Associate in Soil Mechanics, Yale University
New Haven, Conn.

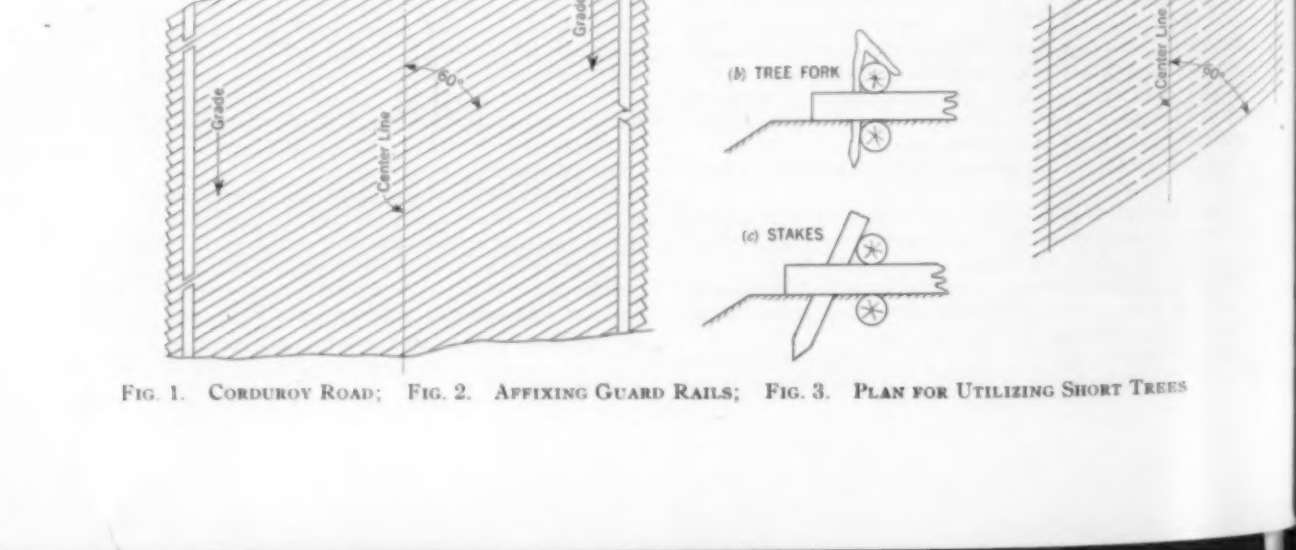


FIG. 1. CORDUROY ROAD; FIG. 2. AFFIXING GUARD RAILS; FIG. 3. PLAN FOR UTILIZING SHORT TREES

Good Engineers Not Always Good Teachers

DEAR SIR: In the May number of CIVIL ENGINEERING, John W. Hayes tells us his view of what a university teacher should be. He gives us a counsel of perfection, probably unattainable. The teacher should, we are told, be well educated, of ample practical experience, sympathetic, a natural teacher rather than a research man. He must be patient, but an average individual—an unlikely combination. He should be a good speaker. Presumably he should be satisfied, having had good practical experience, to take a smaller salary when he starts teaching. He should be a student all his days.

A good teacher does not need to be a competent practicing engineer, nor to have a comprehensive knowledge of the field of engineering. In the usual engineering office a new recruit will find a number of colleagues ready to aid him in his work, eager to show him short and effective methods, prepared to tell him what books or papers he needs to study, and willing to discuss his problems with him. What college preparation is needed, in the field of his immediate tasks, is an acquaintance with mathematics through the calculus, and a solid foundation in physics; certain fields, of course, like chemistry and mining, require specialized training.

One of the nuisances in an office is the young man who has specialized in elastic theory so earnestly that the larger field of common sense is closed to him, at least until his sharper edges have been smoothed away. The difficulty is to get a recruit who realizes that his training has merely provided him with two white chips, and that close application and a willingness to continue his education are essential. A keen mathematician is not necessarily a good engineer.

Out of a dozen qualified graduates, there may be one who will progress indefinitely in an office. In a university, once the teaching foothold is gained, most of the dozen, perhaps all, will continue to teach until they die or are superannuated. Colleges should do a little culling, but they very rarely do. The writer's experience in four universities has induced him to believe that hardly half of the college professors are really competent men. The good research man is, of course, rare, but once found, he is a joy to the profession and an inspiration to his students. There is always a danger of stereotyping students, and here the research man is of great value.

In certain universities abroad there are two kinds of professors, the regular and the supplementary (*ordentliche* and *ausserordentliche*). The first variety is the kind we have, and the second is a rare exception on this continent—he is the man skilled in his field, perhaps a consulting engineer, perhaps the employee of an engineering firm, who takes on a course in a near-by university and brings to his students the sense that an engineering life is real and earnest, that it deals with practical matters in a practical way. Perhaps such a teacher gives his students a new interest in and new keenness for their work. Art is long, and it will take at least as many years in practice as in college to qualify a man as an engineer, and then only if he keeps on studying. The *ordentliche* work, generally speaking, is probably fairly well done in our universities. But there are too many specialized courses for the average student. A little more English, including spelling, a more thorough grounding in the foundation studies, and a good bit less of advanced surveying, differential equations, theory of probabilities—just as instances—would do no harm.

One other thought is perhaps worth consideration. In law schools the work is in part on the "case system." A definite practical problem is set up and discussed at length. The dean of a mechanical engineering department used this method more than a generation ago, greatly to the profit of his students. His problems were thoroughly practical, and did not merely "illustrate the principle."

C. M. GOODRICH, M. Am. Soc. C.E.

Walkerville, Canada

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

For a number of months past Dr. Mead has been answering questions on engineering ethics in these columns. Herewith he gives his views on Question No. 10, which was announced in the May issue. The question states that: "The purchasing agent for a large concern purchases a large number of trucks annually. One particular kind of truck has been very satisfactory and is very popular with the purchasing agent. The makers of this truck also make a pleasure car which the purchasing agent is thinking of buying. When he goes to purchase the car, he finds that the dealer, who is also the dealer from whom he buys the trucks, is willing to sell him the pleasure car at a price a great deal lower than that at which the car is ordinarily sold. Should he buy the car at the price offered?"

In the opinion of the writer it is exceedingly desirable for every man to keep himself as free as possible from personal obligations, which may handicap his future actions or decisions. It seems especially important not to accept personal benefits which may entail the return of favors when the individual is purchasing material or machinery for his client or employer.

It is true that an agent might be willing to forego his personal profit (in whole or in part) on a sale in order to retain the friendship of an agent who is doing business with him regularly and to do so without imposing extra charges on future purchases which the agent may make for his client. But such action approaches perilously near to bribery, and certainly such benefit should never be accepted without the full and complete knowledge and consent of the client or employer.

It is well known that purchases are often induced by granting benefits in cash to the purchasing agent and result in an extra charge on the material or machinery purchased, which must be paid by the client or employer. In such cases the transaction is bribery and a criminal offense. It seems desirable therefore that personal purchases and purchases by agents for others should, so far as possible, be kept entirely separate in order to avoid any appearance of evil.

D. W. MEAD, Past-President and Hon. M. Am. Soc. C.E.

Madison, Wis.

Your Problems in Ethics?

SINCE last September Dr. D. W. Mead has been drawing on his wide experience not only to propound questions of ethical practice for engineers, subsequently opened for general discussion, but to give his views as to the proprieties in each case. A wide group of the Society membership has enjoyed these discussions.

He is now opening his monthly columns still wider by inviting others to submit their problems of ethical practice under the same privilege. That is, discussion is to be welcome, and the final comment will be Dr. Mead's own summary.

Here is the chance to propound that knotty question which has been bothering you, or that particular situation which you think will interest others. To avoid any embarrassment names of persons, or companies, or places can be kept anonymous, as you may desire. Please send through the Editor of CIVIL ENGINEERING, 33 West 39th St., New York, N.Y.

Other problems of professional relations will be treated by Dr. Mead each month. Next in sequence, for study and written discussion by members until August 5, with answers in the September issue, will be the following:

QUESTION NO. 12: *A young engineer is employed by a municipality at a salary of $3,000 per year. Would the engineer be justified in doing private work during his spare time and in retaining the payments for this work for his own use?*

Seventy-Third Annual Convention

Los Angeles, Calif., July 28, 29, 30, 1943

Biltmore Hotel to Be Headquarters

Opening Session and Business Meeting

WEDNESDAY—July 28, 1943—Morning

9:00 Registration

Registration will take place in the Galeria Real near the entrance to the Ballroom.

10:00 Convention called to order in Ballroom by

JULIAN HINDS, *President, Los Angeles Section, Am. Soc. C. E., General Manager and Chief Engineer, The Metropolitan Water District of Southern California,* Los Angeles, Calif.

10:10 Address of Welcome

His Honor FLETCHER BOWRON, *Mayor of the City of Los Angeles,* Los Angeles, Calif.

10:20 Response

EZRA B. WHITMAN, *President, American Society of Civil Engineers.*

10:25 Annual Address

EZRA B. WHITMAN, *President, American Society of Civil Engineers.*

11:00 Engineer Construction in a Theater of War

MAJ. GEN. EUGENE REYBOLD, *M. Am. Soc. C.E., Chief of Engineers, War Department,* Washington, D.C.

11:45 Business meeting

12:00 Luncheon recess

WEDNESDAY LUNCHEON

12:30 p.m., Renaissance Room, Biltmore Hotel

At the close of the Wednesday morning session, there will be a luncheon for members, guests, and their ladies in the Renaissance Room of the Biltmore Hotel. It is expected that a prominent speaker will address the luncheon group, but pending acceptance of the invitation details are being witheld. Full information will be given in the program to be distributed at the meeting.

BILTMORE HOTEL, CONVENTION HEADQUARTERS

WILSHIRE BOULEVARD AND MCARTHUR PARK, LOS ANGELES

Dinner and Entertainment

WEDNESDAY—July 28, 1943—Evening

7 p.m. Ballroom, Biltmore Hotel

Following a social hour at 6 p.m., dinner will be served at 7 p.m. in the Ballroom of the Biltmore Hotel. Entertainment arrangements are not yet sufficiently complete to make definite announcement. Informal dress.

Sessions of Technical Divisions

WEDNESDAY—July 28, 1943—Afternoon

IRRIGATION DIVISION

Galeria "A"

GEORGE L. HENDERSON, *Member, Executive Committee,* PRESIDING

GROUND WATER BASINS AND THEIR UTILIZATION

2:00 **Introductory remarks**

GEORGE L. HENDERSON, *M. Am. Soc. C.E., Chief Engineer and Office Manager, Kern County Land Company,* Bakersfield, Calif.

2:10 **Utilization of Ground Water Basins in the Development of Stream Systems in Arid United States**

HAROLD CONKLING, *M. Am. Soc. C.E., Deputy State Engineer, Water Rights Division,* Sacramento, Calif.

2:45 **Permissible Cost of Artificial Recharge of Ground Water Basins**

GEORGE B. GLEASON, *Assoc. M. Am. Soc. C.E., Senior Hydraulic Engineer, California State Division of Water Resources,* Los Angeles, Calif.

3:20 **Recess**

Discussion by

3:35 RAYMOND A. HILL, *M. Am. Soc. C.E., Leeds, Hill, Barnard and Jewett, Consulting Engineers,* Los Angeles, Calif.

3:50 FINLEY B. LAVERTY, *M. Am. Soc. C.E., Chief Hydraulic Engineer, Los Angeles County Flood Control District,* Los Angeles, Calif.

4:05 MARTIN R. HUBERTY, *Assoc. M. Am. Soc. C.E., Associate Professor of Irrigation, University of California,* Los Angeles, Calif.

4:20 **General discussion**

5:00 **Adjournment**

STRUCTURAL DIVISION

Conference Room 8

R. R. MARTEL, PRESIDING

2:00 **Introductory remarks**

R. R. MARTEL, *Professor of Structural Engineering, California Institute of Technology,* Pasadena, Calif.

2:10 **Structural Design of Camouflage Supporting Structures**

STEPHENSON B. BARNES, *M. Am. Soc. C.E., Consulting Structural Engineer,* Los Angeles, Calif.

2:50 **Discussion by**

RICHARD W. WARE, *Structural Engineer,* Los Angeles, Calif.

3:10 **Structural Features of Lofting Work in Ship Construction**

C. P. HUBERT, *California Ship Building Corporation,* Los Angeles, Calif.

3:50 **Discussion**

4:10 **General discussion**

4:30 **Adjournment**

SANITARY ENGINEERING DIVISION

Conference Room 1

R. F. GOUDEY, *Secretary, Executive Committee,* PRESIDING

2:00 **Operation Results—Water Softening Plant of the Metropolitan Water District of Southern California**

JAMES M. MONTGOMERY, *M. Am. Soc. C.E., J. M. Montgomery & Company, Consulting Engineers,* Los Angeles, Calif.

2:30 **Discussion by**

ROBERT B. DIEMER, *M. Am. Soc. C.E., Chief Operation and Maintenance Engineer, Metropolitan Water District of Southern California*

2:45 **Correlation of Flood Control Works and Water Supply in the Los Angeles Coastal Plain**

FINLEY B. LAVERTY, *M. Am. Soc. C.E., Chief Hydraulic Engineer, Los Angeles County Flood Control District,* Los Angeles, Calif.

3:15 **Discussion by**

A. L. SONDEREGGER, *M. Am. Soc. C.E., Consulting Engineer,* Los Angeles, Calif.

3:30 **Engineering Factors to Be Considered in Drafting Consumers' Rules and Regulations for Water Services**

MAX SOCHA, *Assistant Engineer of Design, Bureau of Water Works and Supply,* Los Angeles, Calif.

4:00 **Discussion by**

L. J. ALEXANDER, *Assoc. M. Am. Soc. C.E., Designing Engineer, Southern California Water Company,* Los Angeles, Calif.

4:10 **Cross-Connection Elimination Program in Los Angeles**

HARRY HAYES, *Assoc. M. Am. Soc. C.E., Assistant Sanitary Engineer, Bureau of Water Works and Supply,* Los Angeles, Calif.

4:40 **Discussion by**

ROY O. VAN METER, *Chief Sanitary Inspector, Bureau of Water Works and Supply,* Los Angeles, Calif.

5:00 **Adjournment**

Metropolitan Water District

SOFTENING AND FILTRATION PLANT, LOS ANGELES, CALIF.

Sessions of Technical Divisions All Day Thursday

THURSDAY—July 29, 1943—Morning

POWER DIVISION

Conference Room 8

R. J. TIPTON, *Member, Executive Committee*, PRESIDING

DETERIORATION AND MAINTENANCE OF CONCRETE DAMS

Program Arranged by the Joint Committee on Masonry Dams

9:30 Introductory remarks

R. J. TIPTON, *M. Am. Soc. C.E., Consulting Engineer*, Denver, Colo.

9:40 Deterioration of Concrete Dams Due to Alkaline Aggregate Reaction

R. F. BLANKS, *M. Am. Soc. C.E., Senior Engineer, U.S. Bureau of Reclamation*, Denver, Colo.

10:20 Discussion

10:40 Experience with Maintenance of Concrete Dams in High Altitudes

W. L. CHADWICK, *M. Am. Soc. C.E., Chief Civil Engineer, Southern California Edison Company*, Los Angeles, Calif.

11:20 Discussion

11:40 General discussion

12:00 Adjournment

SOIL MECHANICS AND FOUNDATIONS DIVISION

Galeria Room

CHARLES H. LEE, *Member, Executive Committee*, PRESIDING

9:30 Introductory remarks

CHARLES H. LEE, *M. Am. Soc. C.E., Consulting Engineer*, San Francisco, Calif.

9:35 Foundations for Quay Walls on Deep Soft Clay

WILLIAM W. MOORE, *Assoc. M. Am. Soc. C.E., Consulting Engineer, Dames & Moore, Foundation Engineers*, Los Angeles, Calif.

Discussion by

10:20 COMDR. GEORGE F. NICHOLSON, *M. Am. Soc. C.E., CEC, U.S.N.R., Public Works Officer, U.S. Naval Dry Docks*, San Francisco, Calif.

10:30 CHARLES H. LEE, *M. Am. Soc. C.E., Consulting Engineer*, San Francisco, Calif.

10:40 Vertical Sand Drains for Stabilization of Foundations

O. J. PORTER, *M. Am. Soc. C.E., Senior Physical Testing Engineer, Materials and Research Department, State Division of Highways*, Sacramento, Calif.

Discussion by

11:25 R. M. GILLIS, *Assoc. M. Am. Soc. C.E., Construction Engineer, State Division of Highways*, Sacramento, Calif.

11:35 WILLIAM W. MOORE, *Assoc. M. Am. Soc. C.E., Consulting Engineer, Dames & Moore, Foundation Engineers*, Los Angeles, Calif.

11:45 General discussion

12:10 Adjournment

Thursday Luncheon

Ballroom, Biltmore Hotel, 12:30 p.m.

Following the close of the technical sessions on Thursday morning, luncheon will be served at 12:30 p.m. in the Ballroom for members and men guests. Ladies will have lunch at the University Club, as announced elsewhere.

SANITARY ENGINEERING DIVISION

Conference Room 1

R. F. GOUDEY, *Secretary, Executive Committee*, PRESIDING

9:30 Experience in Handling Citrus Products Waste

HOWARD W. HALL, *Assoc. M. Am. Soc. C.E., Manager Exchange Lemon Products Company*, Corona, Calif.

10:00 General discussion

10:05 Water Supply and Waste Disposal Problems at Synthetic Rubber Plants

WILLIAM J. O'CONNELL, JR., *Consultant, Technical Consultants Company*, San Francisco, Calif.

10:35 General discussion

10:40 Steel Manufacture Void of Any Final Liquid Wastes

ARTHUR TAYLOR, *M. Am. Soc. C.E., Taylor & Taylor, Consulting Engineers*, Los Angeles, Calif.

11:10 General discussion

11:15 Trends in Design Data for Water Treatment and Sewage Disposal Plants

C. F. HOSTRUP, *M. Am. Soc. C.E., Chief Engineer, Repair and Utilities Division, U.S. Engineer Department*, Los Angeles, Calif.

11:45 Discussion by

A. H. JESSUP, *M. Am. Soc. C.E., Chief Designing Engineer, Leeds, Hill, Barnard and Jewett, Consulting Engineers*, Los Angeles, Calif.

12:00 Adjournment

Entertainment for the Ladies

THURSDAY—July 29, 1943

Luncheon and Entertainment

At 12:30 p.m. the ladies will meet for luncheon at the University Club. Following the luncheon, there will be brief book reviews by several literary celebrities.

Ladies' Theater Party

In the evening all ladies will assemble in the Biltmore Hotel Music Room at 8 p.m. to attend, the play "Claudia," in the adjacent Biltmore Theatre.

THURSDAY—July 29, 1943—Afternoon

POWER DIVISION

Conference Room 8

R. J. TIPTON, *Member, Executive Committee,* PRESIDING

DETERIORATION AND MAINTENANCE OF CONCRETE DAMS

Program Arranged by the Joint Committee on Masonry Dams

2:00 **Introductory remarks**

R. J. TIPTON, *M. Am. Soc. C.E., Consulting Engineer,* Denver, Colo.

2:10 **Repairs of Power House Substructure and of the Dam at Buck Hydroplant**

PHILIP SPORN, *M. Am. Soc. C.E., Vice-President and Chief Engineer, American Gas & Electric Service Corporation,* New York, N.Y.

and

H. A. KAMMER, *Assoc. M. Am. Soc. C.E., Construction Engineer, American Gas & Electric Company,* New York, N.Y.

2:50 **Discussion**

3:10 **Repair Work Done at Guin Dam in Canada**

O. GRAHAM, *Chief Engineer, Quebec Streams Commission* Montreal, Canada.

3:50 **Discussion**

4:10 **General discussion**

4:30 **Adjournment**

SOIL MECHANICS AND FOUNDATIONS DIVISION

Galeria Room

CHARLES H. LEE, *Member, Executive Committee,* PRESIDING

2:00 **Introductory remarks**

CHARLES H. LEE, *M. Am. Soc. C.E., Consulting Engineer,* San Francisco, Calif.

2:05 **Design and Construction of Air Fields**

COL. JAMES H. STRATTON, *M. Am. Soc. C.E., Corps of Engineers, U.S. Army,* Washington, D.C.

Discussion by

2:50 COL. JAMES B. NEWMAN, JR., *Air Corps, U.S. Army Chief, Buildings and Grounds Section, Office of Commanding General, Army Air Force,* Washington, D.C.

3:00 T. E. STANTON, *Vice-President, Am. Soc. C.E., Materials and Research Engineer, State Division of Highways,* Sacramento, Calif.

3:10 **Some Soil Mechanics Features of a West Coast Graving Dock**

FREDERICK J. CONVERSE, *Assoc. M. Am. Soc. C.E., Consulting Engineer, Warren and Converse, Foundation Engineers,* Los Angeles, Calif.

3:55 **Discussion by**

CHARLES T. LEEDS, *M. Am. Soc. C.E., Leeds, Hill, Barnard and Jewett, Consulting Engineers,* Los Angeles, Calif.

4:05 **General discussion**

4:30 **Adjournment**

SURVEYING AND MAPPING DIVISION

Conference Room 1

COMDR. RICHARD R. LUKENS, PRESIDING

2:00 **Introductory remarks**

COMDR. RICHARD R. LUKENS, *M. Am. Soc. C.E., U.S. Coast and Geodetic Survey,* Riverside, Calif.

2:10 **Geodetic Control Surveys in Los Angeles County**

ALFRED JONES, *Assoc. M. Am. Soc. C.E., Los Angeles County Surveyor and County Engineer,* Los Angeles, Calif.

Discussion by

2:50 DONALD L. WILLIAMS, *Engineer, Surveying & Drafting Department, U.S. Engineer Department,* Los Angeles, Calif.

3:10 **Photographic Mapping**

LEON T. ELIEL *Vice-President, Fairchild Aerial Surveys, Inc.,* Los Angeles, Calif.

3:50 **Discussion**

4:10 **General discussion**

4:30 **Adjournment**

Metropolitan Water District

PARKER DAM ON THE LOWER COLORADO

Metropolitan Water District

OUTLET TOWER IN LAKE MATHEWS

Men's Stag Smoker

Thursday, July 29, 1943, Evening

On Thursday evening members and men guests will attend the stag smoker and entertainment to be held at the Jonathan Club at 7 p.m.

Ladies will be free to arrange individually for dinner, prior to their theater party.

Sessions of Technical Divisions All Day Friday

FRIDAY—July 30, 1943—Morning

WATERWAYS DIVISION

Galeria Room

CHARLES T. LEEDS, PRESIDING

9:30 Introductory remarks

CHARLES T. LEEDS, *M. Am. Soc. C.E., Leeds, Hill, Barnard & Jewett, Consulting Engineers,* Los Angeles, Calif.

9:40 Operation of Flood Control Basins, U.S. Engineer District, Los Angeles, Calif.

WILLIAM C. CASSIDY, *Senior Engineer, Chief, Flood Control Subdivision, U.S. Engineer Office,* Los Angeles, Calif.

10:20 Discussion by

ALBERT P. GILDEA, *Assoc. M. Am. Soc. C.E., Head of Hydraulic Section, U.S. Engineer Office,* Los Angeles, Calif.

10:40 Floods from Mountain Watersheds and the Significance of Debris

PAUL BAUMANN, *M. Am. Soc. C.E., Assistant Chief Engineer, Los Angeles County Flood Control District,* Los Angeles, Calif.

11:20 Discussion by

GEORGE L. REYNOLDS, *Assoc. M. Am. Soc. C.E., Forest Engineer, Angelus National Forest,* Los Angeles, Calif.

11:40 General discussion

12:00 Adjournment

ENGINEERING ECONOMICS DIVISION

Conference Room 1

A. P. LEARNED, *Member, Executive Committee,* PRESIDING

9:30 Introductory remarks

A. P. LEARNED, *M. Am. Soc. C.E., Assistant Engineer, Black & Veatch, Consulting Engineers,* Kansas City, Mo.

9:40 The Railroad in Wartime

DR. C. S. DUNCAN, *Economist and Director of Competitive Transportation Research Association of American Railroads,* Washington, D.C.

10:20 Discussion

10:40 Los Angeles Area Transportation in Wartime

D. BATMAN, *Assistant to President, Pacific Electric Railway,* Los Angeles, Calif.

11:20 Discussion

11:40 General discussion

12:00 Adjournment

HIGHWAY DIVISION

Conference Room 8

COL. WILLIAM N. CAREY, *Director, Am. Soc. C.E.,* PRESIDING

9:30 Introductory remarks

COL. WILLIAM N. CAREY, *Director, Am. Soc. C.E., Chief Engineer, Federal Works Agency,* Washington, D.C.

9:40 Development by the Public Roads Administration of Cooperative Road Construction in Latin America

EDWIN W. JAMES, *M. Am. Soc. C.E., Chief of the Inter-American Regional Office of the U.S. Public Roads Administration,* Washington, D.C.

10:10 Discussion

10:20 The Pan-American Military Highway—History, Organization, and Progress

COL. EDWIN C. KELTON, *Corps of Engineers, U.S. Army, Director of Pan-American Highway,* Los Angeles, Calif.

10:50 Discussion by

BRYN BELYEA, *Owner, Pacific Crane & Rigging Company,* Los Angeles, Calif.

11:00 Engineering Problems of Pan-American Military Highway

LT. COL. HAROLD E. SPICKARD, *M. Am. Soc. C.E., Corps of Engineers, U.S. Army, Chief of the Engineering Division of the Pan-American Highway,* Los Angeles, Calif.

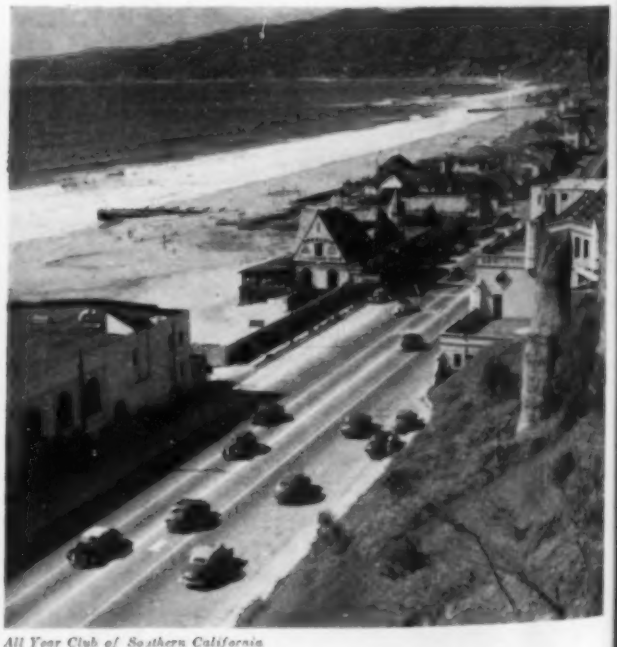
11:30 Discussion

11:40 General discussion

12:00 Adjournment

All Year Club of Southern California

RAILROADS AND FRUIT GO TO WAR



All Year Club of Southern California

CALIFORNIA HIGHWAYS SERVE WARTIME TRANSPORTATION

FRIDAY—July 30, 1943—Afternoon

CONSTRUCTION DIVISION

Conference Room 8

CLYDE W. WOOD, PRESIDING

2:00 **Introductory remarks**

CLYDE W. WOOD, *Assoc. M. Am. Soc. C.E., President, Clyde W. Wood, Inc., General Contractors,* Los Angeles, Calif.

2:10 **Headaches in a Shipyard**

JACK MADDEN, *Consolidated Steel Company,* Los Angeles, Calif.

2:50 **Discussion**

3:10 **Construction of High Octane Gasoline Plants**

FRITZ W. KARGE, *M. Am. Soc. C.E., Project Engineer, Fluor Corporation,* Los Angeles, Calif.

3:50 **Discussion**

4:10 **General discussion**

4:30 **Adjournment**

CITY PLANNING DIVISION

Galeria Room

HUBER E. SMUTZ, PRESIDING

THE EFFECT OF AIR TRANSPORTATION ON FUTURE PLANNING OF AMERICAN CITIES

2:00 **Introductory remarks**

HUBER E. SMUTZ, *Assoc. M. Am. Soc. C.E., Zoning Administrator,* Los Angeles, Calif.

2:10 **The Industry's View of Post-War Air Transport**

ROBERT CROSS, *President, Lockheed Corporation; Chairman, Aviation Committee, Los Angeles Chamber of Commerce,* Los Angeles, Calif.

2:45 **Discussion**

3:00 **The Effect on Other Forms of Transport**

PROF. CHARLES B. BREED, *Director, Am. Soc. C.E., Consulting Engineer,* Boston, Mass.

3:35 **Discussion**

3:50 **Adjusting Post-War City Plans to New Concepts of Air Transport**

DWIGHT GIBBS, *Planning Architect in Charge of Air Transport Studies, Greater Los Angeles Planning Project,* Los Angeles, Calif.

4:25 **Discussion**

4:40 **General discussion**

5:00 **Adjournment**

HYDRAULICS DIVISION

Conference Room 8

J. Q. JEWETT, *Member Executive Committee,* PRESIDING

Program Arranged by Committee on Hydrology

2:00 **Introductory remarks**

J. Q. JEWETT, *M. Am. Soc. C.E., Leeds, Hill, Barnard and Jewett, Consulting Engineers,* Los Angeles, Calif.

2:10 **Frequency of Abnormal Rainfall**

RHODES E. RULE, *Assoc. M. Am. Soc. C.E., Consulting Engineering Geologist,* Burbank, Calif.

2:50 **Discussion**

3:10 **Hydrological Characteristics of Los Angeles County as Derived from the Flood of March 1938**

FELIX O. FRICKER, *Assoc. M. Am. Soc. C.E., Civil Engineer, Los Angeles County Flood Control District,* Los Angeles, Calif.

Discussion by

3:50 DONALD M. BAKER, *M. Am. Soc. C.E., Consulting Engineer, Ruscardon Engineers,* Los Angeles, Calif.

4:10 **General discussion**

4:30 **Adjournment**

SCENE IN A WEST COAST SHIPYARD

AIR TRANSPORTATION VITAL IN WAR AND PEACE

Friday Luncheon

Renaissance Room, Biltmore Hotel, 12:30 p.m.

Following the close of technical sessions on Friday morning, luncheon will be served at 12:30 p.m. in the Renaissance Room for members, guests, and the ladies.

Ladies' Sightseeing Trip

Friday 2:00 p.m.

Following the group luncheon on Friday, all ladies will assemble in the Biltmore Hotel Music Room at 2 p.m. for a sightseeing trip through Los Angeles and vicinity.

Committees on Local Arrangements

Executive Committee

A. L. GRAM, *General Chairman*

WALLACE L. CHADWICK
TRENT R. DAMES
WILLIAM ALFRED DUNNING
ERNEST E. EAST
STERLING S. GREEN
MRS. STERLING S. GREEN
WILLIAM W. HURLBUT
H. MACY JONES
CHARLES T. LEEDS
JOHN F. SKINNER
L. J. ALEXANDER

Entertainment Committee

H. MACY JONES, *Chairman* ROY L. ANDERSON

Transportation Committee

ERNEST E. EAST, *Chairman*

HAROLD F. HOLLEY OLIVER J. SCHIEBER

Committee on Hotel Arrangements

STERLING S. GREEN, *Chairman*

HARRY HAYES
OLIVER J. SCHIEBER
GEORGE E. BRANDOW
MILTON ANDERSON
HERBERT J. CHAPTON

Reception Committee

JOHN F. SKINNER, *Chairman*

JOHN C. ALBERS
DONALD M. BAKER
ARCHER F. BARNARD
EDMUND B. BESSELIEVRE
FRED D. BOWLUS
MERRILL BUTLER
RAY L. DERBY
GERALD C. FITZGERALD
WILLIS T. KNOWLTON
ALFRED JONES
D. LEE NARVER
A. M. RAWN
A. L. SONDEREGGER
FRANKLIN THOMAS
H. A. VAN NORMAN

Committee on Ladies Activities

MRS. STERLING S. GREEN, *Chairman*

WILLIAM W. HURLBUT, *Adviser*

MRS. EDWARD R. BOWEN
MRS. GEORGE E. BRANDOW
MRS. WALLACE L. CHADWICK
MRS. ANDREW L. GRAM
MRS. BURTON S. GRANT
MRS. JULIAN HINDS
MRS. WILLIAM W. HURLBUT
MRS. A. M. RAWN
MRS. THOMAS E. STANTON
MRS. FRANKLIN THOMAS
MRS. H. A. VAN NORMAN

Finance Committee

L. J. ALEXANDER, *Chairman*

CARL B. JOHNSON
VINTON W. BACON
EDGAR A. GRISWOLD
JOHN GUILLAN
JOHN K. MINASIAN

Registration Committee

TRENT R. DAMES, *Chairman*

N. D. WHITMAN, JR. ERNST MAAG
EDGAR A. GRISWOLD

Publicity Committee

WILLIAM ALFRED DUNNING, *Chairman*

JOHN C. ALBERS G. W. OUTLAND

Technical Program Committee

CHARLES T. LEEDS, *Chairman*

HAROLD L. DOOLITTLE
BLAKE BEATTY
RAYMOND F. GOUDEY
TRENT R. DAMES
DONALD M. BAKER
ALFRED JONES
CLAYBURN C. ELDER
SPENCER V. CORTELYOU
DON HULL MCCREERY

Excursion Committee

WALLACE L. CHADWICK, *Chairman*

OLIVER J. SCHIEBER
CHARLES R. COMPTON
ROBERT A. SKINNER
L. J. GARLINGHOUSE

General Announcements

Local Section Conference

TUESDAY—July 27, 1943—Morning and Afternoon

CAPT. FRED H. RHODES, *Member, Society's Committee on Local Sections*, PRESIDING

A Local Section Conference will be held all day Tuesday, July 27, to which representatives of the following Western Local Sections have been invited:

Arizona
Colorado
Hawaii
Los Angeles
New Mexico
Oregon
Sacramento
San Diego
San Francisco
Seattle
Spokane
Tacoma
Utah
Wyoming

The agenda of the Local Sections Conference had not been completed in time for publication in this program. However, some of the subjects to be discussed at the Conference include:

The Engineer's Part in Post-War Planning
Employer-Employee Relationships
The Effect of War on Local Section and Student Chapter Activities
Methods of Encouraging Participation in Local Section Activities
The Collection of Local Section Dues
The Engineer's Part in Public Life

In addition to the official delegates from the above Sections, it is hoped that many members of the Los Angeles Section can arrange to be present. This Conference is open to all members of the Society, and all visitors are cordially invited to take part in the discussions.

Inspection Trip for Saturday

SATURDAY—July 31, 1943—Morning

Following the closing of the technical part of the Convention on Friday afternoon, there will be three inspection trips on Saturday morning. These cover a wide range of interest. Negotiations are under way for visits to the following points of interest:

The Newly Constructed Steel Mill of the Kaiser Company at Fontana
The 100-Million Gallon per Day Water Softening Plant of the Metropolitan Water District of Southern California
One of the Shipyards at the Los Angeles Harbor

Hotel Accommodations

As previously announced, a cordial welcome awaits all members of the Society who are able to attend this meeting, but because of current wartime conditions it is recognized that attendance will be confined largely to those from surrounding areas. It is expected that the Biltmore Hotel will be capable of accommodating all who attend, provided reservations are made promptly.

Biltmore Hotel Rates

Single rooms	$5–7
Double rooms	$7–9

Note: Every room in the Biltmore has individual, private bath. The hotel is located in the heart of downtown Los Angeles, about five minutes from the Union Station.

SOCIETY AFFAIRS

Official and Semi-Official

Engineers Protest Affiliation with Sub-Professionals

Professional Group Intervenes in WLB Case

IN A RECENT hearing before a War Labor Panel at Kansas City, Mo., a group of more than 100 professional engineers and architects engaged on the Sunflower Ordnance Works at Eudora, Kans., appealed for the right to be represented by their own bargaining group and protested inclusion in a bargaining group represented by the International Federation of Technical Engineers, Architects and Draftsmen's Unions, A. F. of L. Local No. 30.

Some months ago the technicians, working on the construction of this hundred-million-dollar ordnance works, organized a union as a branch of the I.F.T.E.A. & D.U., and assumed the right to bargain for the entire technical and professional engineering and architectural personnel working on the site of the project. After several conferences between representatives of the union and the employer, the representatives of the union made the claim that the employer was not bargaining with them in good faith and they carried this claim to the regional unit of the War Labor Board, Region No. 7, in Kansas City. The WLB held a secret election to determine whether the union had within its membership a majority of the engineers, architects, technicians, and draftsmen employed on the project and was thus qualified to claim the bargaining rights for the entire group.

ENGINEERS' COMMITTEE OBJECTS

Before the election was held a committee representing the professional engineers and architects, engaged on the construction of the project, objected to their inclusion in such a secret ballot. They petitioned that the WLB hold two elections, having a ballot of one color for the professional employees and a ballot of another color for the sub-professional employees. This request was denied by the WLB and the secret ballot was held. Some of the professional employees refrained from voting, and others voted that they did not wish to be represented by such a bargaining group. Nevertheless, when the ballots were counted the sub-professional votes outweighed the professional votes in number, and the WLB decided that the Local No. 30 of the A. F. of L. had in fact the majority of the technical and professional members in its union and, therefore, was entitled to the bargaining rights for both the technical and professional employees.

Hearings were immediately started in Kansas City before a War Labor Board Panel in an effort to promote bargaining between the employer and representatives of the A. F. of L. union. At these hearings a committee of the professional employees objected to the recognition by the WLB of A. F. of L. No. 30 as the bargaining unit for both the sub-professional and the professional men on the project. After hearing this testimony the War Labor Panel ruled that it be stricken from the record on the grounds that the question raised by the professional men was of other significance than the one which had already been raised by the union, namely, the question of bargaining for wages, hours, and working conditions. In addition, the War Labor Panel struck this testimony from the records on the grounds that it was presented too late in the proceedings and that the committee of professional engineers had not shown itself to be the accredited representative of any substantial group of employees.

INDEPENDENT ORGANIZATION FORMED

In order to prove that the professional men should be recognized as constituting a bona fide bargaining group, more than 100 professional engineers and architects signed a petition stating that they wished to be represented in a group of their own and that they protested being included in the A. F. of L. Local No. 30 group. These professional engineers and architects, for protection, formed an organization of their own, calling it the "Organized Professional Engineers and Architects of the Sunflower Ordnance Works." Most of those signing are professional engineers and architects, although a small percentage might be classed as in high executive positions, and another small percentage might be classed as pre-professional men who wished to be affiliated with professional men. Of the group signing the petition, those who might readily be called professional engineer and architect employees, as distinguished from pre-professional employees and as distinguished from high executives, numbered between 75 and 80. The entire sub-professional group working on this project, most of whom voted to be represented by A. F. of L. No. 30, numbered around 350. Protest was made on the basis, first, of unfairness in allowing a large number of sub-professional men to dominate a small number of professional men; second, of lack of common interest as defined by law; and, third, of deprivation of the right given employees by the Act to select an appropiate bargaining unit.

The organized professional engineers and architects again appointed a committee to represent them. Some of the members of this professional group and of the committees are members of the American Society of Civil Engineers and they appealed to the Society for advice and assistance. As soon as the appeal reached Society Headquarters the staff member assigned to problems of employment conditions, Howard F. Peckworth, M. Am. Soc. C.E., Assistant to the Secretary, went immediately to Kansas City.

With the help of this member of the Society's staff, the committee representing the professional group made a formal appeal to the WLB, District No. 7, stating that this group of 75 to 80 professional engineers and architects had the right under the law to be heard and that they had the right to ask that their testimony be not stricken from the record as had been done. After consideration of the arguments brought to bear on this case, the committee was allowed to appear again before the War Labor Panel. In order to be of the utmost aid the Society retained the legal firm of Caldwell, Downing, Noble and Garrity of Kansas City to render advice and assistance. It was brought out at the hearing that it was perfectly legal for the members of the professional group to obtain advice and assistance from their national professional society and that the Society could give them assistance through a staff member and through legal counsel retained by it without becoming a party to the case.

PROFESSIONAL GROUP PRESENTS BRIEF TO WAR LABOR PANEL

At this time the committee for the professional group prepared a brief setting forth its position in the matter and stating that its members wished to be represented by their own group; that they protested representation by a group which was dominated by sub-professional men; that they were distinguished from those of the sub-professional group because of having had scientific education and responsible charge of work; that they had no community of interest with the sub-professional group which was composed largely of men who had entered the technical field under the exigencies of the times and most of whom probably would go back to their former occupations as soon as the war effort was over; and that their activities as professional men were clearly distinguishable from the activities of the sub-professional men in that the latter carried out routine duties of a manipulatory nature, whereas the professional men carried out professional assignments under a minimum of supervision and for which they were personally responsible.

In addition to this brief, a longer one was submitted by the council retained by the Society in which it was pointed out that it had long been the policy of the National Labor Relations Board to distinguish professionals from sub-professional workers, and it had clearly been shown that the NLRB did not allow a professional group to be represented by and dominated by a group which was controlled by a majority of sub-professionals. One of the cases cited as supporting this point is that of the chemists employed by the Shell Development Company in Emeryville, Calif.

The second point brought out in counsels' brief was that, even if the professional and sub-professional groups logically might be included in the same unit, or as logically be separated therefrom, it had long been the policy of the NLRB to apply the principle that the desires of the employees involved was the determining factor in the choosing of the appropriate bargaining group. In this case it was clearly shown that the professional engineers and architects desired to be represented by their own group.

NLRB Recognizes Desires of Employees

The third and last point brought out in counsels' brief was that it had long been the policy of the NLRB to recognize that an employee group did not impair its rights by failing to act at the proper moment. The point is that the NLRB, upon receiving further information, has made it a policy to change the appropriate bargaining unit to suit the desires of the employees when these desires are expressed, thereby putting into practical effect the fundamental right given by law that representatives for collective bargaining shall be selected by the employees "in a unit appropriate for such purpose."

The representative of the Society was called upon to define "professional engineer" and to define "professional status." He did so by defining the professional man to be distinguished from the sub-professional man because the work of the former requires skill and imagination, wide latitude for independent action, discretion, and judgment, under minimum of supervision with personal relationship towards his superior In practically all cases the professional man receives higher pay than the sub-professional; he is differentiated from the sub-professional in that he has had engineering training in the fundamentals of science; generally has a learned degree; is qualified to obtain a state license to practice; is qualified for membership in the recognized appropriate national professional society; and has had practical experiences which have qualified him to undertake professional engineering or architectural assignments on his own initiative.

The sub-professional man, on the other hand, was defined as a man who generally has had less education; who has not specialized in engineering or architecture; who does not understand the fundamentals of science; who has not necessarily had valuable practical experiences; whose work has been routine in nature and closely supervised with a minimum of latitude for independent action; and whose work in most cases has been that of the hand rather than of the brain. It was brought out that engineering and architectural professional standing in this country is that of a group of leaders, intellectuals, creators, researchers, designers, and organizers, and that the performances of those who are universally recognized as professionals are not confined rigidly within an 8-hour day or a 40-hour week.

The situation may be summarized somewhat as follows:

This case very clearly shows that a group dominated by sub-professionals was attempting to establish itself as the bargaining agent for the professional engineer and architect employees; that the professional engineer and architect employees did not wish to be represented and outnumbered by a group of sub-professionals and that to protect themselves it was necessary for them to form a bargaining group of their own. It may be said, too, that there is need for recognition of a situation with which the professionally minded employee has not previously had to deal. As this article goes to press, the WLB Panel in Kansas City has not handed down its decision. Further information will be given as soon as received.

Amended Model Registration Law to Be Published

THE MODEL LAW for the Registration of Professional Engineers and Land Surveyors was amended at a conference of representatives of ten national engineering societies held at Society Headquarters on May 24, 1943. The most important amendment was the insertion of provisions for the establishment of the grade of "Engineer in Training." One thousand copies of the law as amended will be printed by the Society for distribution to all interested engineering societies for official approval and endorsement.

National engineering societies collaborating with the American Society of Civil Engineers in the amendments to the "Model Law" were: American Association of Engineers, American Institute of Chemical Engineers, American Institute of Consulting Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, National Society of Professional Engineers, Society for the Promotion of Engineering Education, and the National Council of State Boards of Engineering Examiners. Chairman of the conference was T. Keith Legaré, chairman of the Committee on Registration of Engineers of the American Society of Civil Engineers.

Added to the "Model Law" were the following paragraphs which define the "Engineer-in-Training" and establish fees for the examinations:

"The term engineer-in-training as used in this Act shall mean a candidate for registration as a professional engineer who is a graduate in an approved engineering curriculum of four years or more from a school or college approved by the Board as of satisfactory standing; or who has had four years or more of experience in engineering work of a character satisfactory to the Board, and who, in addition, has successfully passed the examination in the fundamental engineering subjects prior to completion of the requisite years of experience in engineering work, as provided in Section 14 of this Act; and who shall have received from the Board, as hereinafter defined, a certificate stating that he has successfully passed this portion of the professional examinations."

"Application to take the examination in fundamental engineering subjects prior to completion of the requisite years of experience in engineering work shall be accompanied by a fee of seven dollars and fifty cents ($7.50). This amount shall be credited against the total fee required for registration as a professional engineer."

"The Board shall issue to each applicant upon successfully passing the examination in fundamental engineering subjects a certificate stating that he has passed the examination and that his name has been recorded as an engineer-in-training."

Thus provision is significantly made for establishing a professional standing while attaining the experience required for full registration as a "professional engineer." The states of Ohio and New York have already established the procedure of splitting registration examinations into two parts so that understanding of "fundamental engineering subjects" may be tested soon after graduation from an engineering college.

Papers Sometimes Too Valuable to Print

PARADOXICAL as it may seem, many intensely important papers of civil engineering interest are barred from release because of their basic value to the war effort. In effect, therefore, it may be said that papers are "lost" because they are too good.

In the mood of the time, we propose that engineers undertake to write up their censored projects now, while the subjects are "hot" and enthusiasm runs high. In that happy future day when swords are once more converted into plough-shares, the technical paper reserve, or shelf of material, can begin to produce vital information at onee. This "reserve" concept is particularly important as regards the type of material suitable for TRANSACTIONS. We therefore invite the deposit of manuscripts in this "bank" to draw "interest" at some future date.

Important technical ideas now subject to censorship can and should be put into material form in black and white. Such papers could then be held by the authors until present restrictions no longer apply; or, better still, they could be forwarded to the Society with the understanding that final release would have to await the end of the war. The latter plan has considerable advantage because the paper could be studied on behalf of the Publications Committee and some determination of value or projected revision and improvement could be made. This would then advance the prospects of the paper and shorten the interval before publication, once the restrictions are removed.

Members are therefore urged not to hesitate in submitting their technical articles. The Publications Committee is always willing to recognize situations which call for either expediting or delaying actual printing by the Society

One Thousandth Meeting of the Sacramento Section

By STEWART MITCHELL, Assoc. M. Am. Soc. C.E.

ONE thousand has become a significant number. For example, mankind has long looked forward to the millenium—one thousand years of happiness and perfect order. It is fitting, therefore, that the culmination of 1,000 meetings by the Sacramento Section should be considered an event of unusual distinction and worthy of celebration. The Section has just reached its manhood, being 21 years old this year; and although younger than some thirty-odd other Sections of the Society, it is the first to attain this enviable meeting record. Its one-thousandth meeting was held June 15, 1943. Such a notable occasion deserves special mention in these pages.

THE Sacramento Section draws its membership from a large and diversified area. It extends well into the sage-covered plains of northern Nevada. It includes the pine-clad slopes of the northern Sierras and that portion of the great Central Valley of California drained by the Sacramento River. Of course its headquarters, and chief source of membership, is Sacramento, the capital city and chief distribution point for this large area.

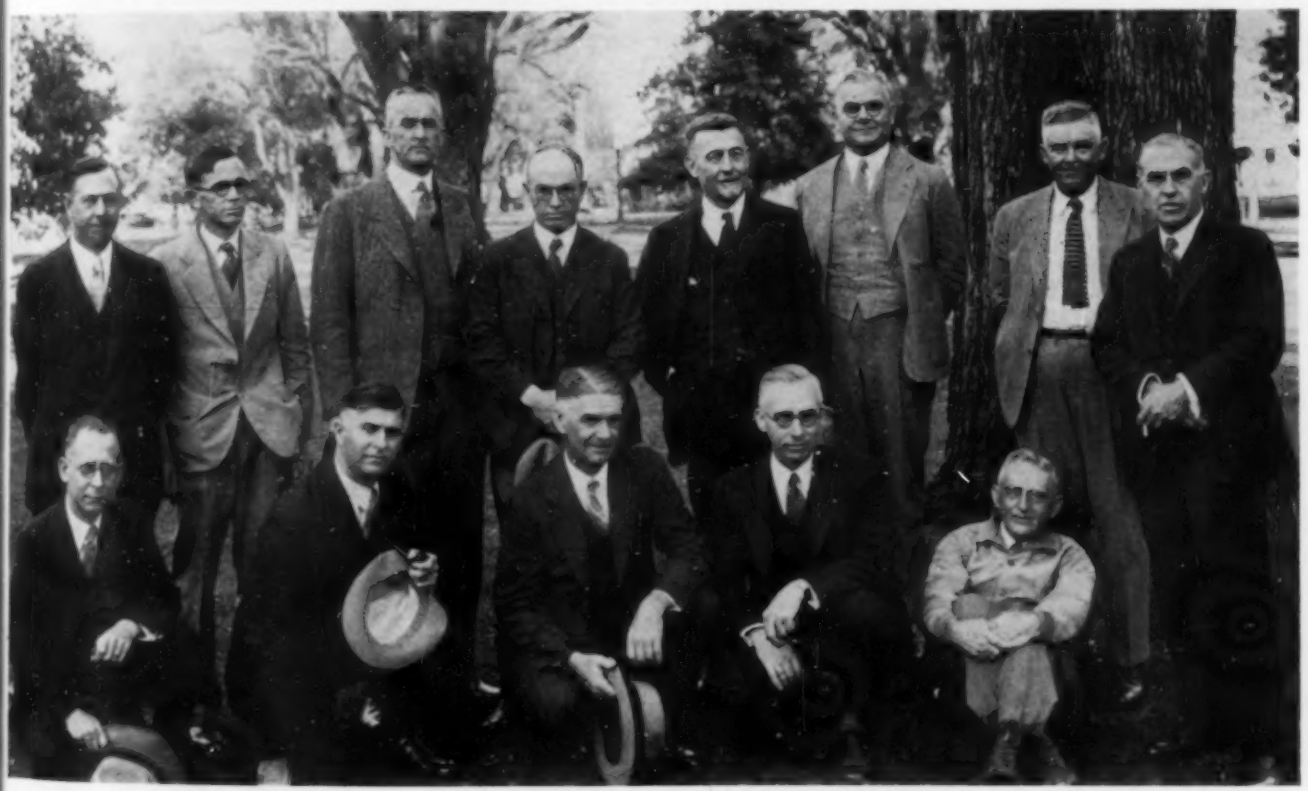
Here are the headquarters for federal and state engineering departments. For the state, the Division of Highways, the Division of Water Resources, and the Division of Architecture are important engineering organizations. Agencies of the federal government—such as the Corps of Engineers, the Bureau of Reclamation headquarters for the Central Valley Project, and the Geological Survey—and military establishments like the Sacramento Air Depot contribute many members. Engineers from the Southern Pacific Company, the Western Pacific Railroad, the Pacific Gas and Electric Company, and the City and County Engineer's Offices are regular attendants at the meetings.

CONTINUING INTERESTS

Looking back to April 19, 1922, Norwood Silsbee, historian of the Section, tells of the first formal meeting held at lunch time in a local grill. Thirty-two Society members attended, elected officers, and adopted a constitution. It is worthy of mention that Historian Silsbee, himself, was present at that meeting as well as at 935 other of the first thousand meetings of the Section, a record that will be hard to beat. He says several rugged individualists had objected to the national Secretary's request that the constitution conform closely to that of the San Francisco Section. This other California group had been the first Local Section of the Society to be formed, and its constitution was considered a pattern for all others to follow. However, the argument was settled without bloodshed and, in fact, a spirit of cooperation and friendliness was conspicuously present at that first meeting.

That such a spirit has lasted is apparent from the fact that of the 41 engineers connected with the Section during its first year, 23 are still members and a few others who moved away still retain a non-resident membership. Ten have passed to the Great Beyond. Fourteen of these first members subsequently served as president of the Section—one of them, T. E. Stanton, has been Director and is now Vice-President of the Society, and another, Fred C. Scobey, is now Director from this District.

The Sacramento Section holds regular weekly luncheon meetings. Since the first thousand meetings were concluded in about



NOTABLE GATHERING AT SACRAMENTO, APRIL 1930

Officers of the Society and of the Section in Capital Park at the Society's Spring Meeting. All of those local officers still living remain active in the Section. Standing, left to right: Thomas E. Stanton, President of the Section, 1930; Edward Hyatt, Past-President, Sacramento Section, 1923; Frederick H. Fowler, of San Francisco, President of the Society, 1941; Albert Givan, Past-President, Sacramento Section, 1922; John F. Coleman, of New Orleans, President of the Society, 1930; Everett N. Bryan, Past-President, Sacramento Section (Deceased); Drury Butler, Past-President, Sacramento Section, 1927; George T. Seabury, New York, Secretary of the Society (1925 to date).

Front row, left to right: Norwood Silsbee, Secretary-Treasurer, Sacramento Section, 1930, President, 1938; J. Burdette Brown, Past-President, Sacramento Section, 1928; Charles S. Pope, Past-President, Sacramento Section (Deceased); Joseph W. Gross, Past-President, Sacramento Section, 1929; and Joseph C. Boyd, Past-President, Sacramento Section, 1925.

21 years, it will be apparent that deviations from the weekly schedule have been few. Except for very infrequent business meetings, there is always a speaker who is allowed from one-half to three-quarters of an hour for his talk. The subjects are normally of technical or current interest to engineers. Record turnouts occurred when 303 persons heard N. A. Bowers, M. Am. Soc. C.E., tell about, and show movies of, the Tacoma Bridge disaster. A slightly smaller crowd heard H. W. Richardson, M. Am. Soc. C.E., tell the story of building the Alcan Highway. A meeting much publicized afterward was that of October 24, 1941, at which Admiral John W. Greenslade talked on "The Navy's Part in the Defense of the Pacific." In connection with special events, members of the Section have journeyed to Reno, Nev., and to Redding, Calif., to hold regular and supplementary meetings.

SOCIAL FEATURES EMPHASIZED

One important special meeting of the Sacramento Section—the Christmas Jinks—is held on the Tuesday before Christmas Day. For this occasion the clock is stopped and the regular hour of adjournment, one-thirty, postponed as long as the universal spirit of conviviality lasts. Fortified by a reasonable amount of liquid sustenance, members are in a mood to overlook the Thespian limitations of the amateur actors who seek to portray the foibles of dignified Section members or quip at the idiosyncrasies of the engineering profession in general. Of course, it is all clean fun. But if, as seems impending, meetings are to be regularly attended by lady members, the style of some of the present available theatrical talent may be cramped.

One meeting a year is designated "Ladies' Day." After luncheon, the hall is turned over to the lady relatives and friends to amuse themselves and become better acquainted. The annual dinner dance of the Section is a popular affair and always well attended.

The Student Chapter of the University of Nevada comes under the wing of the Sacramento Section, and since 1935, an annual award has been made to its outstanding student. In 1940 the Section pioneered a Speakers' Club which, led by a competent instructor, aids the members to stand up and say what they have to say without undue quaking at the knees. A "Junior Forum," organized in 1939, flourished mightily until it had to cease its activities because most of its members had joined the armed forces. The "Engineerogram," printed monthly, informs the 375 members of coming events and publishes items of general interest.

A SPECIAL CELEBRATION

In order to have time to celebrate fittingly the 1,000th meeting, the time was changed from the regular luncheon hour to an evening meeting. At 8 p.m. the members gathered in the American Legion Hall of Post No. 61 to take stock of their heritage and to talk of the future. President Obermuller opened the meeting with some 200 members and guests present. After the secretary read several letters and telegrams of congratulation the meeting was turned over to the chairman of the evening, Fred Grumm. The chairman then recited some of the more interesting facts concerning the past history of the Section and devoted the greater part of the program to a presentation of charter members and past-presidents of the Section. Introduction of distinguished guests was omitted because the chairman decided that the meeting was more distinguished than the guests.

Levity and jokes were introduced by having a representative of the Junior members quiz the veterans about past activities to which they responded nobly. Prizes were awarded for various qualifications: the oldest and the youngest members, the one coming from the greatest and least distance, and many others. Cheese, olives, crackers, and beer were consumed in large quantities to end a very successful evening. Thus the first thousand meetings of the Sacramento Section were completed on a harmonious note of combined enthusiasm and conviviality—also, it may be said, with plenty of vigor left over to start on a new series.

Committee on Post-War Construction Appointed

ANNOUNCEMENT may now be made of the appointment by President Whitman of a Committee on Post-War Construction. It will be the responsibility of this group to provide leadership in the present planning of post-war construction.

The Board of Direction has been reluctant to give emphasis to the need for post-war public works while the tide of war was against us, although as long ago as October 1941 the Board adopted a set of principles that should obtain with respect to post-war construction. (See CIVIL ENGINEERING for November 1941, page 677.) Now, however, it is believed that the time has come for definite thinking on what must be done to alleviate the probable post-war unemployment when cessation of war materiel production will cease and millions of those now in the services will be returning to civil life.

That there is an ever-accumulating reservoir of useful public works of great magnitude is certain and that, to make the construction of those works practicable immediately the last shot is fired, an active program of present planning of those works should be inaugurated is equally certain. This, it will be the effort of the Committee on Post-War Construction to bring about.

Chairman of the Committee is G. Donald Kennedy, M. Am. Soc. C.E., vice-president of the Automotive Safety Foundation and former Michigan State Highway Commissioner. Other appointees are Adolph J. Ackerman, Dean G. Edwards, Frederick H. Fowler, Gustav J. Requardt, and Frank T. Sheets, all Members of the Society. Mr. Ackerman, member of the Executive Committee of the Construction Division of the Society, is director of engineering for the Dravo Corporation, Pittsburgh, Pa. A Director of the Society from District 1, Mr. Edwards is consulting engineer for the Borough of Manhattan, New York City.

Mr. Fowler, Past-President of the Society and recently elected president of the Society of American Military Engineers, has long been a consulting engineer familiar with all types of West Coast projects. A consulting engineer in Baltimore, Md., Mr. Requardt is Director of the Society from District 5. Mr. Sheets, former chief highway engineer of the Illinois Division of Highways, is now president of the Portland Cement Association.

The first meeting of the Committee was held in the Washington office of the Society on May 26. Present at this meeting, in addition to the members of the Committee, were President Whitman, Secretary Seabury, and Assistant to the Secretary, Mr. Hale. The several important matters discussed all focused on the practicabilities, and also the limitations, resident in those public works and private works also, that would be intrinsically useful to their communities and to their private owners. The formulation of a thesis, outlining both these practicabilities and limitations, was decided to be the first task of the Committee. Later will come decisions on the procedures whereby the principles thus set forth will be made effective.

These topics and a further drafting of the Committee's conception of a practicable program of useful program of post-war public works occupied the Committee's attention at its second meeting, held also in Washington, on June 14 and 15 last, when all members were present. It is the Committee's intention to meet again on June 28, when it will formulate its ideas more concretely for presentation to the Board of Direction and distribution to the membership.

Society's Advice Sought on Washington, D.C., City Plan

A precedent was established in Washington, D.C., on May 21, when representatives of nine professional societies met to confer on the planning of the Capital. Brigadier General U. S. Grant, 3d, chairman of the National Capital Park and Planning Commission, invited the delegates to meet with the commission so that their organization might become actively interested in the development of a Washington Plan.

The American Society of Civil Engineers was represented by Harold M. Lewis, M. Am. Soc. C.E. Other societies represented were the American Federation of Arts, American Institute of Architects, American Institute of Planners, American Planning and Civic Association, American Society of Landscape Architects, Garden Club of America, National Sculptors' Society, and the National Society of Mural Painters.

John F. Stevens, 1853–1943

ALTHOUGH he has been in retirement for a number of years, John F. Stevens' fame is still world wide. His death in Southern Pines, N.C., on June 2 ended one of the most illustrious careers in the annals of American engineering.

He inherited a strong mind, a splendid constitution, and an indomitable will. With these he developed himself until he was a leader of American engineering. His fame rests largely upon his accomplishments as chief engineer and later chairman of the Isthmian Canal Commission. There he laid the foundation of what was to be the successful accomplishment of a tremendous piece of construction. Almost equally important, and widely publicized at the time, was his brilliant service in Russia following World War I. He was chairman of the Commission of Railway Experts, and later president of the Inter-Allied Technical Board, charged with the administration and supervision of the Chinese Eastern and Siberian Railways. His accomplishment constituted a brilliant feat not only in engineering but in diplomacy, for which he received numerous foreign honors.

His work in America was largely concerned with railways. After a number of years with the Great Northern Lines he became chief engineer. He later was vice-president of the Chicago, Rock Island and Pacific, and still later of the New York, New Haven and Hartford Railroad. His most spectacular accomplishment was when he was still a young man. Accompanied at first by a half-breed guide, and finally alone in bitter winter weather, he discovered the Marias Pass, one of the finest gateways through the Rocky Mountains, now used by the main line of the Great Northern. To commemorate this great event, the railroad erected a heroic monument to Mr. Stevens, which was dedicated in the summer of 1925. On this occasion the Society also was honored in that its President, Robert Ridgway, was privileged to deliver the principal address.

The epic feat that this monument memorializes is thus graphically portrayed by the late Alfred D. Flinn, M. Am. Soc. C.E.

"On the night of December 11, 1889, the winds howled through the canyons and defiles of the Rocky Mountains in the Blackfoot Indian country, while on the Continental Divide a lone engineer tramped back and forth through the snow in the darkness fighting for his very life against a temperature forty degrees below zero. He must live, for he had a momentous message. He had found a way to the Pacific, and knew it to be the best railroad location across the great mountain barrier! John F. Stevens had discovered Marias Pass

DEDICATION OF THE STEVENS STATUE AT MARIAS PASS, JULY 21, 1925, AS MR. STEVENS REENACTED HIS HISTORIC EXPLOIT

"Only those who have suffered can truly sympathize .... One who has always rolled about on wheels in cushioned luxury over rails or well built highways cannot know the self-reliance, the exertion, the privation, the fatigue, the triumph, the joy of one who on foot made his way through trackless forests, across rugged mountains, in winter's freezing winds, over treacherous snow, alone, as did John F. Stevens and other engineers of his generation."

JOHN FRANK STEVENS, HON. M. AM. SOC. C.E.

Since 1888, Mr. Stevens has been a member of the Society. He was further recognized in 1922 when he was made Honorary Member and again in 1927 when he became President of the Society. Other important honors include a degree of Doctor of Laws from Bates College, the John Fritz Medal for notable scientific achievement, and the Hoover Medal "for distinguished public service."

It is men like John F. Stevens who have greatly enhanced the reputation of civil engineers.

Papers Available in Engineering Societies Library

MANY EXCELLENT papers submitted to the Society cannot be presented to the profession in its regular publications. From time to time, therefore, the Committee on Publications designates certain of these for filing in the Engineering Societies Library. Here they are available for reference, or photo prints of them may be secured by arrangement with the Library. Quotations on the cost of this service may be had from the Engineering Societies Library, 29 West 39th Street, New York, N.Y. With the approval of the authors, the following papers have recently been so filed.

RAILWAY AND HIGHWAY TRANSITION CURVE

DAVID E. HUGHES, M. Am. Soc. C.E., (deceascd), "The Sickle, or the Ideal Railway and Highway Transition Curve" (15 handwritten pages of text, two figures, a 6-place table of "sickular functions"). This is a mathematical treatment of the transitional curve. The tables have also been used somewhat in detailing steel structures.

COASTAL EROSION

THORNDIKE SAVILLE, M. Am. Soc. C.E., "Coastal Erosion Problems and Planning" (18 pages of text). This paper was originally presented before the Waterways Division at the Society's January 1942 Annual Meeting, and was discussed by Brig. Gen. John J. Kingman and Arthur S. Tuttle, Past-President, Am. Soc. C.E. The discussions are filed with the paper. The results of a number of experiments are given, together with a discussion of the work of various beach erosion agencies.

TEST RESULTS—REINFORCED CONCRETE

PAUL W. ABELES, "Tests on High-Grade Reinforced Concrete Construction" (7 pages of text, tables, curves, and illustrations). These test data were assembled at the Technical universities in Vienna, Austria, Ljubljana, Jugoslavia, and Brno, Czecho-Slovakia, and add to our knowledge of the plastic action of concrete and the prestressing of reinforcing steel.

ANALYSIS OF BUILDING FRAMES

RALPH W. STEWART, M. Am. Soc. C.E., "Amplified Slope Deflection Applied to Building Frames" (18 pages of text and diagrams). Attention is called to the geometry of structural theory by this analysis of slope deflection computations. Simplification of this phase of the method is the purpose of the paper.

News of Local Sections

Recent Activities

BUFFALO SECTION

At the May luncheon meeting of the Section the speaker was George F. Unger, general superintendent of the Niagara Frontier Bridge Commission. Mr. Unger gave a brief history of city planning in Buffalo from 1813 down to the present, pointing out the local accomplishments of city planning on a large wall map prepared for the purpose. The principal improvements so far achieved are Southwestern Boulevard, Furhman Boulevard, and the Grand Island Bridge with the Sheridan Drive connection at the southerly end. Proposed improvements, which come under the head of post-war planning, include a high-level bridge over, or a tunnel under, Buffalo River as well as various boulevard projects.

CENTRAL OHIO SECTION

The last meeting of the season was held on the campus of Ohio State University on the evening of May 20. The guest speaker was R. W. Meredith, assistant superintendent of the Columbus plant of the Curtiss-Wright Corporation, who gave a talk of great interest to the members on airplane-production problems. Mr. Meredith also showed pictures of the manufacture of P-40 planes at the Buffalo plant.

CLEVELAND SECTION

"The Railroads' Wartime Responsibilities" was the subject of discussion at the May meeting of the Cleveland Section, the speaker being Harry VonWiller, vice-president in charge of traffic for the Erie Railroad. Shortly after we entered the last war the government took control of the railroads, Mr. VonWiller pointed out, because of failure on the part of the railroads to accomplish the necessary freight movement. Immediately after the close of the war, governmental agencies and railroad representatives started to form plans for more efficient operation in case of another war. The result of this planning was that, although the railroads now have 500,000 fewer cars than during the first World War, freight has been handled so efficiently that no car shortage has developed. Despite the tremendous burdens thrown on the railroads, they are doing their work strikingly well, Mr. VonWiller concluded.

COLORADO SECTION

On May 10 members of the Colorado Section heard Leonard F. Bohner discuss his experiences in a Japanese internment camp in southeast Asia. Mr. Bohner, who was for a number of years engaged in missionary activities in the East, was away from his station in Singapore at the time the war broke out and consequently unable to obtain any word of his family until he rejoined them some eight months later in the United States. During the evening it was announced that the Section's prize of Junior membership in the Society goes to G. W. Curtis, of the University of Colorado, for his paper on the All-American Canal. A number of Student Chapter members from the University of Colorado were dinner guests of the Section before the meeting.

DISTRICT OF COLUMBIA SECTION

The road system at the Pentagon Building was discussed at the May meeting by Joseph Barnett, principal highway design engineer for the Public Roads Administration. Illustrating his talk with lantern slides, Mr. Barnett showed how it was possible to design and construct, in record-breaking time, a new system of roads to meet the demands of the 40,000 employees in the Pentagon Building. Later in the evening, Maj. Gen. Eugene Reybold, Chief of Engineers, discussed the need of the Corps of Engineers for men with skill in technical construction. There is need for the enlistment of 9,000 such specialists each month, General Reybold pointed out.

GEORGIA SECTION

There were 67 present at a joint meeting of the Section and the Georgia Engineering Society, which took place on May 24. A talk on "The Civil Aeronautics Administration in the War Effort" comprised the technical program, the speaker being H. Harvie Perkins, supervisor of airports for the Civil Aeronautics Administration. Mr. Perkins stated that 85% of the traffic along the 34,000 miles of airways controlled by the CAA is military. He also discussed a number of the vital war functions now performed by CAA and explained the features of the airways—beacons, landing fields, radio beam, traffic control, and instrument approach systems—which have developed in the past few years into an integrated system comparable in magnitude to the great railroad and highway networks of the country. At the regular luncheon meeting, held on May 7, Garland Peyton, state geologist of Georgia, discussed the different minerals useful to the war effort that are found in Georgia.

ILLINOIS SECTION

A symposium on lumber was the feature of a joint meeting of the Section and the Western Society of Engineers, held on May 6. Those taking part were Laurence P. Keith, structural engineer in charge of the Chicago office of the National Lumber Manufacturers' Association, and Leo Kraemer, director of research in charge of forest utilization for the Edward Hines Lumber Company, of Chicago. The latter discussed the use of lumber for war purposes, while Mr. Keith's subject was "Structural Lumber Comes of Age." Both talks were illustrated by lantern slides, and a sound motion picture, entitled "Trees for Tomorrow," was also shown.

KANSAS CITY SECTION

During the early spring members of the Kansas City Section enjoyed an inspection tour of the partially constructed Pratt and Whitney plant. The tour was conducted by Tracy Wood, H. H. Parsons, A. E. Barnes, and O. A. Vopel. More recently—on May 26—Ladies' Night was celebrated at the Mission Hills Country Club. During dinner Mrs. Lawrence K. Whyte, sister of Director E. E. Howard, entertained at the piano, and the after-dinner speaker was Robert T. Sloan. Then Kenneth K. King, director of the Kansas City Water Department, presented two reels of motion pictures showing the various plants and properties of the department and some of its more important operations. A considerable footage of the film was devoted to the water-purification plant and the recently added accessory softening equipment. The various officials of the department were present, and a lively discussion of water-supply problems concluded the program.

KENTUCKY SECTION

A joint session of the Kentucky Section and the Student Chapters at the University of Kentucky and the University of Louisville took place in Louisville on May 14. Following dinner, it was announced that the winners of the Section's annual prizes of Junior membership in the Society are Larry Pindley, of the University of Kentucky, and Earl F. Gibbons, of the University of Louisville. Six students then presented papers in the Section's annual competition for student prize papers. A committee of judges finally decided that the first prize of $15 should go to J. A. Caywood, of the University of Kentucky, for his paper on timber construction; the second prize of $10 to G. J. Rappleyea, of the University of Kentucky, for his paper on flight strips; and the third prize of $5 to N. G. Johnson, of the University of Louisville, for his paper on portable airports.

LOS ANGELES SECTION

On May 12 members of the Section were guests of the Student Chapter at the California Institute of Technology in Pasadena. The first speaker was Robert K. Mitchell, Student Chapter member, who discussed the subject of engineering education as adapted to war conditions. An interesting talk on "Present Trends in Aircraft Design," was then presented by Dr. Clark B. Millikan, professor of aeronautical engineering at the Institute. Dr. Millikan illustrated his talk with pictures and diagrams, those showing experimental planes using jet propulsion proving especially interesting.

MARYLAND SECTION

Speakers at the May meeting of the Section were Howard F. Peckworth, assistant to the Secretary of the Society, and Hal H. Hale, the Society's Washington representative. The former discussed "Employment Conditions Among Engineers," while Mr.

Hale explained Senate Bills S-702 and S-607 now pending before that body and their effect on engineers. After some general discussion, it was decided that each member should write his representatives in Congress expressing disapproval of these bills. At the conclusion of the program Ezra B. Whitman, President of the Society, made a few remarks on the post-war planning that should be undertaken by state and municipal authorities at the present time.

METROPOLITAN SECTION

A symposium on "Recent Developments in Shipbuilding Facilities" was the feature of the April meeting of the Section. The principal speaker was Adolph J. Ackerman, director of engineering for the Dravo Corporation in Pittsburgh, who outlined the resourceful methods that have been used to place modern shipbuilding on an "assembly line" basis. Mr. Ackerman also gave interesting details of a system utilizing submerged shipway basins that allow six ships to be constructed at once. This method makes it possible to lower both the time and cost of construction, as the ships may be launched simply by flooding the basins. Discussion was led by Carlton B. Jansen, manager of the contracting division of the Dravo Corporation, who described the unusual construction problems encountered in the use of submerged shipways. There were over 400 present.

MICHIGAN SECTION

A talk on the technical training of the Engineers' Corps of the U.S. Army comprised the technical program at the April meeting of the Section. The speaker was Col. P. N. Strong, recently appointed district engineer in charge of the U.S. Engineer Office at Detroit. Colonel Strong described the construction of tunnels and fortifications at Corregidor, where he was assigned prior to 1939, and showed moving pictures of actual maneuvers, including the construction of roads and tank traps and blocks.

MID-MISSOURI SECTION

At the April meeting of the Section—held in Columbia on the 30th—Dean Frank L. Mott, of the school of journalism at the University of Missouri, spoke on "Engineering as Viewed by the Press." Dean Mott stressed the fact that the general reading public is interested in engineering subjects, provided they are suitably written. The May meeting, which was held in Jefferson City, took the form of a joint session with the Jefferson City Engineers' Club. The feature of the occasion was a talk on "Current Events in Engineering Research," given by F. V. Reagel. In his talk Mr. Reagel, who is engineer of materials for the Missouri State Highway Department, discussed prestressed concrete and improvements in testing devices for concrete and cement. An inspection of the highway testing laboratory concluded the program.

MID-SOUTH SECTION

On May 5 members of the Mid-South Section met in Vicksburg, Miss., for a dinner with the Vicksburg Engineers' Club. Later there was a technical session, at which Joel D. Justin, Philadelphia (Pa.) consultant, was the principal speaker. Mr. Justin gave an illustrated talk on the repair and maintenance of dams. Following a discussion of his talk, Gerard H. Matthes, director of the U.S. Waterways Experiment Station, presented a comparison of the results obtained by the diamond-point and shot-drill methods of investigating foundations for dams.

NEW MEXICO SECTION

At the May meeting of the Section—held in Albuquerque on the 19th—it was announced that Richard Hudson Clough, of the University of New Mexico, has been selected as the recipient of the Section's annual prize of Junior membership in the Society. During the absence from the state of William G. Bratschi, secretary-treasurer of the Section, John O. Joerns was appointed to serve in his stead. A talk on the "Laboratory Analysis of the Structural Properties of Some New Mexico Soils" comprised the technical program. This was given by W. K. Wagner, research technician for the New Mexico State Highway Testing Laboratory.

NORTHWESTERN SECTION

A number of Student Chapter members were guests of the Northwestern Section at a meeting held at the University of Minnesota on May 3. During the evening announcement was made of the winners of the Section's prizes of Junior membership in the Society. They are H. G. Bauer, of South Dakota State College; R. E. Thayer, of the South Dakota School of Mines; L. A. Sites, of the University of North Dakota; C. Hjalmarson, of North Dakota State College; and J. P. Fosness (first prize), H. A. Doepke (second prize), and R. G. Gilles (third prize), of the University of Minnesota. In the ceremonies of presentation, Mr. Bauer responded for the prize winners, and Walter Reid, president of the University of Minnesota Chapter, spoke briefly. The speaker of the evening was Dean S. C. Lind, who discussed the civil engineer in war and peace.

PHILADELPHIA SECTION

An illustrated talk on the Alcan Highway was the feature of the May meeting of the Philadelphia Section. This was given by A. C. Clark, principal highway engineer for the Public Roads Administration, who discussed the part played by the Administration in the construction of the project. In conclusion, Mr. Clark emphasized the excellent team work between the Army engineers, the Public Roads Administration, and the contractors. Dudley T. Corning, chief of the Philadelphia Bureau of Highways and Street Cleaning, was chairman of the evening.

PROVIDENCE SECTION

At the May meeting of the Providence Section, Ralph W. Horne spoke on the new sewage-treatment works at Cranston, R.I. Mr. Horne, who is connected with the Boston firm of Fay, Spofford, and Thorndike, gave a detailed description of the various units and their functions as well as operating results. His talk was illustrated with lantern slides.

ROCHESTER SECTION

The Rochester Section reports two meetings in May. At the annual Ladies' Night, the after-dinner speaker was the Rev. Donald Bruce MacQueen, who discussed his personal observations of the Orient. Motion pictures of life in China, Japan, and the Philippines supplemented his talk. On the 20th there was a joint meeting with the Rochester Engineering Society, the speaker being E. Leland Durkee. Mr. Durkee, who is resident erection engineer for the Bethlehem Steel Company at Bethlehem, Pa., gave an illustrated lecture on the erection of the Rainbow Bridge at Niagara Falls, N.Y.

ST. LOUIS SECTION

A talk on safety comprised the technical program at the April meeting of the Section. This was given by Reyburn T. Hoffman, secretary-manager of the St. Louis Safety Council, who stated that 500 million man-days were lost last year as a result of accidents. Mr. Hoffman showed that, while considerable progress has been made in the reduction of industrial accidents, it is much harder to prevent those occurring in the homes of workers and away from the plants.

Members attending the May meeting had the privilege of seeing a sound motion picture in technicolor, entitled "Kukan! The Battle Cry of China." Filmed in the interior of China and smuggled out, the film gave an intimate view of the people in the various sections of the country and showed their unconquerable spirit under the most trying conditions. Robert B. Brooks, St. Louis consultant, gave a preliminary speech, describing the background of the film and predicting that the Assam Road—the new highway from India to China, which was started when the fall of the Burma Road impended—will soon be opened.

SAN DIEGO SECTION

On April 22 Harry Campbell addressed a meeting of the Section on his engineering experiences in the Soviet Union, where he went with a group of aeronautical engineers from the United States to assist in solving design and construction problems. Mr. Campbell is research engineer for the Solar Aircraft Company.

SEATTLE SECTION

Members of the Section were guests of the Student Chapter at the University of Washington on April 26. Following dinner, there was considerable discussion of Section and Student Chapter affairs. The group then adjourned to see two films—"Prelude to

War" and "The Nazis Strike"—shown through the courtesy of the Office of War Information and Col. T. G. Thompson.

SPOKANE SECTION

At the May meeting of the Section announcement was made of the winners in the annual student prize contest sponsored by the Section. The recipients of these prizes of Junior membership in the Society are James Spofford, of the University of Idaho; Harold Gourlie, of Washington State College; and Harold Eagle, of Montana State College. A talk on Society affairs was then given by John W. Cunningham, Director of the Society. In his talk Mr. Cunningham discussed the spring meeting of the Board of Direction, post-war planning, union activity among engineer employees, and the methods of the Army and Navy in recruiting engineer officers.

TACOMA SECTION

A symposium on timber comprised the technical program at the April dinner meeting of the Section. The program was opened with the presentation of a color film, which showed the vast natural resources of the forests of the Northwest. A paper on the prefabrication of timber structures was then read by Arthur E. W. Dodds, chief engineer for the Weyerhaeuser Sales Company. The second speaker was Walter J. Ryan, chief engineer for the Weyerhaeuser Timber Company, who described various railroad bridges built by his company. The Baird Creek Bridge, in southwest Washington, a combination three-hinged arch of 120-ft span with frame-trestle approaches, is an outstanding example of timber ring-connected construction, Mr. Ryan pointed out.

What caused the fall of the Tacoma Narrows Bridge and how to design a span that will not have its weaknesses is still a live subject, members of the Section were told at a joint meeting with the Seattle Section, held on May 11. The principal speaker was O. H. Ammann, New York City consultant, who was in Seattle attending a three-day session of the National Advisory Committee on the Investigation of Long-Span Suspension Bridges. Various members of the committee joined in the subsequent discussion of Mr. Ammann's talk and lauded the work being done at the University of Washington and the part the Washington Toll Bridge Authority is playing in helping finance studies in bridge construction. Later the group adjourned to the wind tunnel, where a 50-to-1 scale model of the ill-fated Tacoma Narrows Bridge has been erected for testing and calibration purposes.

TOLEDO SECTION

The first meeting of the newly formed Toledo Technical Council, of which the Toledo Section is one of twelve participating groups, took place on May 21. There were about 200 present to hear T. A. Boyd, the speaker of the evening, discuss the timely topic, "Oil and Turmoil." Mr. Boyd, who is director of fuel development for the General Motors Laboratories at Detroit, Mich., illustrated his talk with movies and lantern slides. Later a sound film, depicting the process of manufacturing pursuit planes and actual test-flight demonstrations, was shown through the courtesy of the Curtiss-Wright Corporation. The stated purpose of the Toledo Technical Council "is to bring closer association between the engineering and technical societies in the Toledo area in order to further serve the engineering profession and promote effective educational programs."

TRI-CITY SECTION

The Army and Navy training program being undertaken at Iowa City was discussed by Dean F. M. Dawson, of the University of Iowa, at the April meeting of the Section. Papers on "Trends in Sewage Treatment for War Construction" and "Sanitary Engineering Features of War Projects" comprised the technical program. These were given by Herman S. Smith and C. M. Stanley, Jr., both of the Stanley Engineering Company at Muscatine, Iowa. The speaker at the May meeting—held in Davenport, Iowa, on the 28th—was J. S. Dodds, professor of civil engineering at Iowa State College, who discussed land surveying.

UTAH SECTION

On May 16 about 90 members and guests of the Utah Section traveled by bus and automobile to the Geneva Steel Plant of the Columbia Steel Company. Before making a tour of the plant, the group was shown a large model of the plant, and J. K. Lamoree, chief engineer of the plant, explained the various features of layout and operation. Luncheon was served in the plant cafeteria, and the return trip to Salt Lake City was made via the Ironton plant, where a 200,000-ton blast furnace is in operation and a 300,000-ton furnace is just being completed. The group was told that the Geneva plant was being constructed as near the ideal as possible.

WEST VIRGINIA SECTION

Members of the West Virginia Section met at Morgantown, W.Va., on May 7 for afternoon and evening sessions. Speakers on the afternoon program were C. F. Goodrich, chief engineer of the American Bridge Company and Director of the Society, who discussed "Welding in the Structural Steel Industry"; and W. S. Downs, professor of transportation engineering at West Virginia University, who described the proposed "Greater Morgantown Belt Line Highway." Discussion of the latter subject was led by George W. McAlpin, state construction engineer for the State Road Commission of West Virginia. Following a dinner in the evening, Howard F. Peckworth, assistant to the Secretary of the Society, discussed the activities of the Society in guarding the interests of civil engineers in employment relations. Dean R. P. Davis, of West Virginia University, then presented the Section's prize of Junior membership in the Society to A. S. Cappellari, and Mr. Cappellari responded with his impressions of "A Student Looking at the Society." The final speaker on the program was C. G. Dunnells, Pittsburgh consultant, who described the construction of six government warehouses at Marietta, Pa.

Student Chapter Notes

GEORGIA SCHOOL OF TECHNOLOGY

Society members Van Porter Enloe and Melvin Williams were present at a meeting of the Georgia School of Technology Student Chapter, which took place on May 26. Since the students expressed a desire to have a practicing engineer point out some of the trials and tribulations that they would encounter in their professional life, Mr. Williams obliged with a discussion of problems they might expect to meet. Mr. Williams is associate engineer for the U.S. Geological Survey at Atlanta.

COLLEGE OF THE CITY OF NEW YORK

On May 20 the Student Chapter at the College of the City of New York elected officers for the coming year. These are Fred Roll, president; A. J. Forns, vice-president; Frank Padar, secretary; and George Tomlinson, treasurer.

CIVIL ENGINEERING in Army Camps

LETTERS addressed to Headquarters from men in military service have indicated great interest in Society publications. Now comes a development which reaffirms, or perhaps results directly from, this popularity.

In the three months following March 1, about 200 subscriptions of similar character have been received for CIVIL ENGINEERING. These have come from Army Post engineers or from others in authority. They have had no special geographical pattern, as camps located throughout the country are represented. Some were from internment camps, others from arsenals, airfields, and training centers. Of course a great many came from regular Army camps.

It has always been a fair inference that this publication is well liked by service men. Doubtless articles on the military effort or on features connected with war activities explain the popularity in part. Also, it is believed that the usual articles and the professional features, which attempt to present in a pleasing way interesting or basic developments in the field of engineering, have proved an attraction.

This latest evidence of interest provides added inspiration in the effort to publish the best that the profession has to offer. Continued cooperation of members and Local Sections in maintaining the high standard of CIVIL ENGINEERING is needed.

ITEMS OF INTEREST

About Engineers and Engineering

Corps of Engineers' Recruiting Dinner

DESPITE the sultry weather, more than 1,500 construction men attended a dinner at the Hotel Commodore, in New York City, on June 3 to open a recruiting drive for the U. S. Corps of Engineers. The purpose of the dinner, which was sponsored by the construction industry of metropolitan New York, was to acquaint construction men with the urgent need of the Corps of Engineers for qualified technicians. The principal speaker of the evening was Maj. Gen. Eugene Reybold, M. Am. Soc. C.E., Chief of Engineers, U.S. Army. Excerpts from General Reybold's address follow:

THE scene is shifting from the areas of preparation here at home to the actual theaters of war, where there lies ahead a tremendous task for construction workers. We must provide and maintain the facilities for supply lines. It is not so much a change of pace as a change of emphasis that has occurred. Most of the construction activities and responsibilities are being transferred to foreign shores, and most of the work, of necessity, must be done with troop units whose skilled workers and officers are drawn in large numbers from the ranks of the construction industry.

During the construction period in this country, we have been fortunate in having large numbers of skilled employees deferred from the draft—their military service delayed because they were needed more urgently on the home front than they were on the battle front. The situation has changed. These skills are now being called for in the actual theaters of war. With their responsibility here largely past, many of these skilled employees are subject to selective service.

Under the circumstances, it would be a tragic mistake for these men themselves and for the further prosecution of the war, if they were not enlisted in jobs where they may continue to utilize their skills. To make this possible, a plan has been worked out whereby, through voluntary induction, applicants from 18 to 38 years of age may continue their skills with the Corps of Engineers. Voluntary enlistments may also be taken for applicants between 38 and 50 years of age.

Volunteering will be through local Selective Service Boards. Representatives of our division, district, and area engineer offices throughout the country have been instructed to interview these men to determine their qualifications for the special skills required for our troop units. Those who qualify will be given a letter which will designate them for the Corps of Engineers. This letter will be honored at the applicant's induction station, provided, of course, he volunteers before his order number comes up.

We solicit your help in securing these specialists for the Corps of Engineers. Such men coming into military service will be assigned to general service regiments, aviation engineer battalions and regiments, combat engineer battalions, bridging and ponton units, water supply units, and other such outfits which require a high degree of skilled personnel. Units thus created are to be activated for use in actual theaters of war. They are not to be used as construction units in continental United States, where they would be in competition with the contractors and workers of this country.

The way is open for such men to earn specialists' and non-commissioned officer ratings. Our promise to these men is that we will teach them how to fight with the tools they already know how to use. They will be trained at our engineer training centers for the specific jobs ahead. We want them to be just as good soldiers as they are workers—ready for combat as well as for work. We believe this program affords a real opportunity for America's skilled workmen who are now anxious to use their skills in uniform.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

HIGHLIGHT of the July dinner session of our Engineers' Club found Joe Kerr offering his coffee to the mochaphile who would buy the most War Savings Stamps. When the auction was over, the coffee, now cold, had been knocked down for a $50 bond. "There's an idea," exclaimed Professor Neare. "If the average Yank will loan Uncle Sam $5 in return for a second cup of coffee, we could finance the war with an airmada of Coffee Clippers on the Brazil run.

"Which reminds me that we left two airmadas in a showdown fight last May, the Yanks starting 1,000 strong and scoring once per man per 10 days. The problem was to bracket the strength of the japs, who scored once per man per 40 days. Who can tell the lower limit such that the Yanks faced extermination?"

"2,000!" echoed a chorus.

"No argument on that, I guess. How about the upper limit, such that the Yanks win by salvaging one-half their losses after three days?"

"That's too tough," moaned Joe. "I tried a differential equation, but it involved the strengths of one day with the differential Yank strength of 3 days before. However, the limit is less than 2,828—the answer, if salvage is immediate."

"I can reduce that to 2,700," said Cal Klater, "but the method is too intricate to explain here. This presumes 3 whole days lost; if a pilot downed on Day 1 misses Days 2 and 3 and works on Day 4, the limit is 2,736."

"Near enuf, Cal, altho I found it lower. By dividing jap scores in two halves—one permanent and one estimable as an effective gain in jap strength for the next 3 days, it develops that this effective gain is reflected on both jap and Yank strengths in a simple infinite series. For the general case:

$$j < Y\left[2b(1-r) - \frac{r^n}{a}(1-r^n)\right]$$

where j and Y are initial strengths of japs and Yanks, a and b are the score-recurrence periods (10 and 40 days), n is the salvage period (3 days), and r, the daily reduction rate of effective strength, is implied in:

$$r(1-r+r^2)(1-r^n) + 2a\flat(1-r)^2\,1$$

For the problem, $r = 0.9662985$ and $j = 2{,}686$.

"Here's an easier one for these dog days. Alenfer de l'Axe, my foreign correspondent, writes that the camouflage of pyramids in Egypt can now be disclosed. So that Axis planes overhead, observing azimuth and parallax of base, would be misled in correcting compass and altimeter, the pyramids were partly painted to simulate a smaller square base inscribed in the real one. In particular, one which was 119 pics high on a base 204 pics square was made to appear 156 pics square. What area was painted and how much was azimuth affected?"

[Cal Klaters were few—just Richard Jenny and James R. Bole—tho many solved the lower limit correctly. To the 13 different methods of solving the April problem, add 3 which were delayed in the mails—from Dead Beat (Col. Malcolm Elliott), Bennie N. Netzer, and Robert N. Woodbury.]

Flag Cover for CIVIL ENGINEERING Again

DURING the week of July 4th news and periodical stands throughout the country will reflect the patriotism of a nation at war with a multitude of flags displayed on all magazine covers. Instrumental in the success of this program has been the National Publishers Association, which has solicited the cooperation of all publications.

Last year a similar campaign met with singular success and widespread public acclaim. It is the hope of CIVIL ENGINEERING that the flag on this month's cover will inspire its readers with a feeling of gratitude to their country and with a realization of its needs rather than eliciting tearful but quickly forgotten sentiment.

Manpower Commission Announces Engineer Shortages

ANNOUNCEMENT has been made by the War Manpower Commission that acute shortages are expected to occur in the fields of sanitary, electrical, radio, mechanical, aeronautical, marine, industrial, chemical, and metallurgical engineering. Although the greatest need will be for skilled technicians in these occupations, a certain number of professional engineers will doubtless be required.

The report intimates that there are 280,000 American professional engineers, of whom 19% are in the armed forces and in civilian positions in the Army and Navy departments. Another 12% are in other governmental positions; 49% in manufacturing, mining, and construction; and 20% in transportation, communication, public utilities, consulting offices, and colleges. In all engineering colleges, the senior classes for the year 1942–1943 numbered only 17,000. Of this number, 6,400 are committed to the armed forces through the enlisted reserve programs.

To meet present and future needs for technicians, government-sponsored war-training courses in engineering, science, and management can provide many technically trained men and women. Likewise, many engineers may take short courses which will enable them to fill in demands for other types of engineers. The situation will be relieved to some extent by the release from service in the War Department of 100,000 civilian employees. Doubtless many engineers will be included in this number, which constitutes nearly 80% of all civilian workers in this department.

Wartime Traffic Control Booklet Offered

IN COOPERATION with 15 national organizations interested in highway transportation, the Office of Defense Transportation has prepared a guide, "Fitting Traffic Control to Wartime," for use by local traffic authorities in readjusting control devices.

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The booklet can be obtained by traffic control personnel from the Local Transport Division of the Office of Defense Transportation, Washington, D.C.

Society Members on Technical Advisory Board of A.I.S.C.

AT A recent meeting of the Board of Directors of the American Institute of Steel Construction several members of the Society were elected to the Technical Advisory Board of the organization. This group—Herschel H. Allen, F. A. Burdett, and C. A. Trexel—brings to 18 the number of Society members on the Board.

Formed ten years ago by the Institute, the Technical Advisory Board consists of engineers of nationally recognized authority who serve in an advisory capacity. The Board assists the Institute in its work of coordination of architectural and engineering technical requirements for structural steel with industrial standards and economy of design in the public interest. Under the guidance of the Board these standards are kept abreast of new developments in structural engineering and fabricating technique.

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doctor of engineering from New York University at its commencement exercises held in New York City on June 9. General Somervell is commanding general for Service of Supply, with headquarters in Washington, D.C. He was recently elected an Honorary Member of the Society.

DECEASED

MAURICE FRITCHLEY BROWN (M. '05) consulting engineer of Boston, Mass., died suddenly at his home at Winchester, Mass., on May 21, 1943, on his seventieth birthday. Except for a period of war service with the U.S. Shipping Board, Mr. Brown was with the Boston Bridge Works from 1898 to 1928—from 1901 on as chief engineer. He then became a member of the Boston firm, Harty and Brown, and since 1933 had been a member of the Waghorne-Brown Company, also of Boston.

JOHN ERWIN CARPENTER, Jr., (Jun. '40) 1st lieutenant in the U.S. Army, has been killed in action. He was 24. Following his graduation from the Agricultural and Mechanical College of Texas in 1940, Mr. Carpenter was connected with the Texas State Highway Department. Before being sent overseas, he was stationed at Fort Logan, Colo.

LEONARD CARTER CRANFORD (Jun. '40) a second lieutenant in the Air Force of the U.S. Army, was killed in a crash in New Jersey on September 19, 1942, though the Society has just heard of his

thirty years. Earlier in his career he maintained an architectural and structural engineering practice at Buffalo, N.Y.

CLARENCE WALTER HUDSON (M. '00) retired consulting engineer of Upper Montclair, N.J., died at his home there on May 10, 1943. On May 20 he would have been 76. From 1892 to 1906 Mr. Hudson was designing engineer for the Phoenix (Pa.) Bridge Company. In 1907 he established a consulting practice in New York, which he maintained until his retirement in 1933. Coincidentally, for part of this period (1907 to 1927), he was in charge of the civil engineering department of the Polytechnic Institute of Brooklyn. During his career as a consultant Mr. Hudson designed the Victory Bridge at Perth Amboy, N.J., the Washington Bridge at Providence, R.I., and many other notable spans. Long a member of the Society, Mr. Hudson served as Director from 1920 to 1922.

DAVID ANDREW KEEFE (M. '13) county engineer for Bradford County (Pa.), died at Athens, Pa., on May 17, 1943, at the age of 74. Mr. Keefe, who for many years maintained a consulting practice at Athens, designed the reinforced steel pier at Atlantic City and built twelve bridges over the Susquehanna River. At one time he was president of the Merchants and Mechanics National Bank at Athens.

DON PIATT KEELOR (M. '40) senior engineer for the U.S. Engineer Office at Kansas City, Mo., died there on April 30, 1943. Mr. Keelor, who was 53, had been in the government engineering service for almost twenty-five years. During the first World War he served in the Corps of Engineers.

JAMES HENRY MINER (M. '09) assistant supervising engineer for the U.S. Bureau of Reclamation on Grand Coulee Dam in Washington, died at his home near the project on May 31, 1943. He was 65. Mr. Miner was with the Bureau of Reclamation for two periods in his career—from 1904 to 1918 and, again, from 1934 to his death. In the intervening period he was with the Dwight P. Robinson Company, of New York, and supervising engineer for the United Engineers and Constructors, Inc., of Philadelphia. From 1928 to 1932 Mr. Miner was engaged on the construction of the Buenos Aires subway for Ferro Carril Terminal Central de Buenos Aires.

ANDREW NEWTON OUTZEN (Assoc. M. '24) superintendent of the River Rouge Plant of the Michigan Consolidated Gas Company, Detroit, Mich., died on August 26, 1941, though the Society has just heard of his death. Mr. Outzen, who was 56, spent most of his career in public utilities work. He had been superintendent of the Madison (Wis.) and the Binghamton (N.Y.) Gas Works, and from 1920 on was connected with the construction and operation of the River Rouge Plant.

LOUIS CHARLES ROCKETT (M. '31) highway engineer for the Public Roads Administration at Santa Fe, N.Mex., died there on April 13, 1943. Mr. Rockett, who was 54, had been in the Santa Fe branch office of the Public Roads Administration since 1922. Earlier in his career (1917 to 1918 and 1919 to 1922) he was with the Wisconsin State Highway Commission. During the first World War he served with the U.S. Army on the location and construction of railroads.

EDWARD HENRY ROCKWELL (M. '12) professor emeritus of civil engineering at Lafayette College, Easton, Pa., died in Easton on May 26, 1943, at the age of 74. Professor Rockwell began his teaching career in 1902 at Tufts College, remaining there until 1922. From the latter year to 1928 he was dean of engineering at Rutgers University, and from 1928 to his retirement a year ago he was professor of civil engineering at Lafayette. Professor Rockwell also acted as consultant to various groups, including the commission

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NEWS OF ENGINEERS

Personal Items About Society Members

C. EARL WEBB, designer of bridges and division engineer for the American Bridge Company at Chicago, Ill., has been elected president of the Western Society of Engineers for the year 1943–1944.

CHARLES C. MORRIS, formerly senior highway engineer for the Public Roads Administration at San Francisco, Calif., has been named acting district engineer for the organization. He succeeds CHARLES H. SWEETSER, who retired on March 31 after twenty-seven years as district engineer.

JAMES F. SANBORN is now a member of the engineering and architectural firm of Sanborn, Fitzpatrick, and Murphy, which has opened offices at 101 Park Avenue, New York.

JUNIUS R. GARDNER, who is a captain in the Sanitary Corps of the U.S. Army, has been assigned as assistant medical inspector at Fort Francis E. Warren, Wyo. Prior to being commissioned he was assistant engineer for Warren and Van Praag, Inc., at Decatur, Ill.

A. T. MCDONALD, county highway engineer for Fulton County, Georgia, and president of the Georgia Section of the Society, was recently commissioned a lieutenant in the Construction Battalions of the U.S. Navy. At present he is stationed at Williamsburg, Va. While Mr. McDonald is on active duty L. R. EPPERSON will be acting county engineer.

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FRED W. STIEFEL, until lately chief engineer and manager for Samuel R. Rosoff, Ltd., at Kerhonkson, N.Y., has organized the Stiefel Construction Corporation, with offices at 595 Madison Avenue, New York City. The organization will specialize in tunnel, subway, underpinning, and other heavy construction projects.

MELVIN A. DOBBS is now a first lieutenant in the Sanitary Corps of the U.S. Army, stationed at Camp Grant, Ill. He was previously sanitary engineer for the East Side Health District at East St. Louis, Ill.

ELMER K. NELSON, consulting civil engineer of Laramie, Wyo., has gone to Sacramento, Calif., to do special post-war planning work in investigating Sacramento Valley resources.

THOMAS B. LARKIN was recently promoted from the rank of brigadier general in the Corps of Engineers, U.S. Army, to that of major general.

BURTON G. DWYRE has resigned as New Mexico state highway engineer in order to accept a position in Brazil with Pan-American Airways, Inc.

GEORGE T. DEAN, until lately assistant professor of civil engineering at Alabama Polytechnic Institute, has been commissioned a lieutenant in the U.S. Naval Reserve and assigned to duty with the Seabees. At present he is stationed at Williamsburg, Va.

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GLEN E. EDGERTON was recently promoted from the rank of brigadier general in the U.S. Army to that of major general. General Edgerton is governor of the Canal Zone.

CHARLES F. KETTERING, vice-president and director of the General Motors Corporation, Detroit, Mich., received the honorary degree of doctor of science from Columbia University at the annual commencement exercises held in New York City on June 1.

D. MAURICE BERRY, who is with the U.S. Navy, has been assigned to the 51st Naval Construction Battalion and is located at Dutch Harbor, Alaska.

RICHARD F. SILBERSTEIN, of Sacramento, Calif., is now a technical corporal in the U.S. Signal Corps, stationed at Camp Murphy, Fla.

DRURY BUTLER, civil and mining engineer of Sacramento, Calif., is with the U.S. Army on a new assignment as industrial specialist with the "Small War Plant Corporation."

BREHON B. SOMERVELL, lieutenant general, Service of Supply, U.S. Army, was a recipient of the honorary degree of doctor of engineering from New York University at its commencement exercises held in New York City on June 9. General Somervell is commanding general for Service of Supply, with headquarters in Washington, D.C. He was recently elected an Honorary Member of the Society.

DECEASED

MAURICE FRITCHLEY BROWN (M. '05) consulting engineer of Boston, Mass., died suddenly at his home at Winchester, Mass., on May 21, 1943, on his seventieth birthday. Except for a period of war service with the U.S. Shipping Board, Mr. Brown was with the Boston Bridge Works from 1898 to 1928—from 1901 on as chief engineer. He then became a member of the Boston firm, Harty and Brown, and since 1933 had been a member of the Waghorne-Brown Company, also of Boston.

JOHN ERWIN CARPENTER, Jr., (Jun. '40) 1st lieutenant in the U.S. Army, has been killed in action. He was 24. Following his graduation from the Agricultural and Mechanical College of Texas in 1940, Mr. Carpenter was connected with the Texas State Highway Department. Before being sent overseas, he was stationed at Fort Logan, Colo.

LEONARD CARTER CRANFORD (Jun. '40) a second lieutenant in the Air Force of the U.S. Army, was killed in a crash in New Jersey on September 19, 1942, though the Society has just heard of his death. He was 24 and a native of Washington, D.C. Following his graduation from the University of Maryland in 1940, Mr. Cranford became junior engineer for the U.S. War Department on the Washington National Airport project. In November 1941 he volunteered for the Army Air Force, receiving his "wings" in July 1942.

DE WITT CLINTON FENSTERMAKER (Assoc. M. '08) died at his home at Itasca, Ill., on April 6, 1943. Mr. Fenstermaker, who was 69, spent his engineering career in railroad service, having been with the Chicago, Milwaukee, St. Paul and Pacific for the last twenty-six years of his active life. He served in Company A 2 U.S.V. Engineers and in Company 15 U.S.V. Signal Corps in the Spanish-American War. In January of this year Mr. Fenstermaker was awarded a life membership in the Society.

JANON FISHER (M. '98) of Eccleston, Md., died in Baltimore, Md., on April 27, 1943, at the age of 80. For many years a contracting engineer in Baltimore, Mr. Fisher built the Fallsway and many other public utilities in that city.

JOHN T. N. HOYT (M. '29) chief civil engineer for Albert Kahn, Associated Architects and Engineers, Inc., of Detroit, Mich., died in that city on April 15, 1943. Mr. Hoyt, who was 76, had been chief engineer for Albert Kahn, Inc., for almost thirty years. Earlier in his career he maintained an architectural and structural engineering practice at Buffalo, N.Y.

CLARENCE WALTER HUDSON (M. '00) retired consulting engineer of Upper Montclair, N.J., died at his home there on May 10, 1943. On May 20 he would have been 76. From 1892 to 1906 Mr. Hudson was designing engineer for the Phoenix (Pa.) Bridge Company. In 1907 he established a consulting practice in New York, which he maintained until his retirement in 1933. Coincidentally, for part of this period (1907 to 1927), he was in charge of the civil engineering department of the Polytechnic Institute of Brooklyn. During his career as a consultant Mr. Hudson designed the Victory Bridge at Perth Amboy, N.J., the Washington Bridge at Providence, R.I., and many other notable spans. Long a member of the Society, Mr. Hudson served as Director from 1920 to 1922.

DAVID ANDREW KEEFE (M. '13) county engineer for Bradford County (Pa.), died at Athens, Pa., on May 17, 1943, at the age of 74. Mr. Keefe, who for many years maintained a consulting practice at Athens, designed the reinforced steel pier at Atlantic City and built twelve bridges over the Susquehanna River. At one time he was president of the Merchants and Mechanics National Bank at Athens.

DON PIATT KEELOR (M. '40) senior engineer for the U.S. Engineer Office at Kansas City, Mo., died there on April 30, 1943. Mr. Keelor, who was 53, had been in the government engineering service for almost twenty-five years. During the first World War he served in the Corps of Engineers.

JAMES HENRY MINER (M. '09) assistant supervising engineer for the U.S. Bureau of Reclamation on Grand Coulee Dam in Washington, died at his home near the project on May 31, 1943. He was 65. Mr. Miner was with the Bureau of Reclamation for two periods in his career—from 1904 to 1918 and, again, from 1934 to his death. In the intervening period he was with the Dwight P. Robinson Company, of New York, and supervising engineer for the United Engineers and Constructors, Inc., of Philadelphia. From 1928 to 1932 Mr. Miner was engaged on the construction of the Buenos Aires subway for Ferro Carril Terminal Central de Buenos Aires.

ANDREW NEWTON OUTZEN (Assoc. M. '24) superintendent of the River Rouge Plant of the Michigan Consolidated Gas Company, Detroit, Mich., died on August 26, 1941, though the Society has just heard of his death. Mr. Outzen, who was 56, spent most of his career in public utilities work. He had been superintendent of the Madison (Wis.) and the Binghamton (N.Y.) Gas Works, and from 1920 on was connected with the construction and operation of the River Rouge Plant.

LOUIS CHARLES ROCKETT (M. '31) highway engineer for the Public Roads Administration at Santa Fe, N.Mex., died there on April 13, 1943. Mr. Rockett, who was 54, had been in the Santa Fe branch office of the Public Roads Administration since 1922. Earlier in his career (1917 to 1918 and 1919 to 1922) he was with the Wisconsin State Highway Commission. During the first World War he served with the U.S. Army on the location and construction of railroads.

EDWARD HENRY ROCKWELL (M. '12) professor emeritus of civil engineering at Lafayette College, Easton, Pa., died in Easton on May 26, 1943, at the age of 74. Professor Rockwell began his teaching career in 1902 at Tufts College, remaining there until 1922. From the latter year to 1928 he was dean of engineering at Rutgers University, and from 1928 to his retirement a year ago he was professor of civil engineering at Lafayette. Professor Rockwell also acted as consultant to various groups, including the commission

on the reconstruction of the Galveston Causeway.

JOHN FRANK STEVENS (M. '88) Past-President and Honorary Member of the Society, died at his home at Southern Pines, N.C., on June 2, 1943. He was 90. In charge of many notable construction projects, Mr. Stevens had been chief engineer of the Panama Canal Commission and chairman of the Russian Railway Commission. A more detailed biography and photographs appear in the Society Affairs section of this issue.

EDWY LYCURGUS TAYLOR (M. '20) of New Haven, Conn., died at Camden, Me., on May 17, 1943, at the age of 63. In 1906—after several years of college teaching—Mr. Taylor entered the engineering department of the New York, New Haven and Hartford Railroad. At the time of his retirement in 1930 he was assistant to the executive vice-president. From 1931 to 1941 Mr. Taylor was commissioner of the Public Utilities Commission of Connecticut. During the first World War Mr. Taylor served overseas with the U.S. Army, having the rank of first lieutenant.

EDGAR KENNARD WILSON (M. '26) chief engineer of the Pitometer Company, New York, N.Y., died on March 31, 1943, at the age of 64. Early in his career Mr. Wilson was resident engineer for the Philadelphia and Western Railroad and the Portland (Me.) Water District, and assistant engineer on the construction of the Panama Canal. From 1912 on he was chief engineer and treasurer of the Pitometer Company.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From May 11 to June 9, 1943, Inclusive

ADDITIONS TO MEMBERSHIP

ALBERT, GUS MARTIN (Jun. '42), 1st Lt., U.S. Army, Box 245, Worland, Wyo.

ALEXANDER, FREDERICK JAMES (M. '43), Structural Engr., Southern California Gas Co., 1700 Sante Fe Ave., Los Angeles (Res., 149 Hart Ave., Santa Monica), Calif.

ARGRAVES, NEWMAN EDWARD (Assoc. M. '43), Design Engr., Haller Eng. Associates, Inc., 38 Memorial Drive, Cambridge (Res., 41 Groveland St., Dorchester), Mass.

ATHENS, NICHOLAS (Jun. '43), Corporal, Company C, 1525th Service Unit, U.S. Army, Phoenix Hotel, Room 269, Lexington, Ky.

AUFEROTH, JOHN, JR. (Jun. '43), Structures Engr., Fisher Aircraft Div., Gen. Motors Corp., Memphis, Tenn.

BAIRD, WILLIAM CARDWELL (Jun. '43), Ensign, CEC, U.S.N.R., 2585 East Ave., Rochester, N.Y.

BAKER, MICHAEL, JR. (Assoc. M. '43), Civ. Engr. and Surveyor, Baker Bldg., Box 111, Rochester, Pa.

BERGER, LOUIS HERMAN (M. '43), Pres., C. L. Berger & Sons, Inc., 37 Williams St., Roxbury, Boston, Mass.

BERNSTEIN, BERTRAM PHILIP (Jun. '43), Junior Naval Archt. U.S.N., Norfolk Navy Yard (Res., 401 Westmoreland Ave.), Portsmouth, Va.

BESKIN, LEON (Assoc. M. '43), Senior Stress Analyst, Consolidated Vultee Aircraft Corp., Allentown, Pa. (Res., 493 Fairview Ave., Bridgeport, Conn.)

BLEICH, FRIEDRICH (M. '43), With Am. Inst. of Steel Constr., Inc., 101 Park Ave., New York 17 (Res., 102 West 80th St., New York 24), N.Y.

BRANNIAN, JAMES DONALD (Jun. '43), 2d Lt., U.S.M.C., 2530 Franklin St., Bellingham, Wash.

BUJA, LOUIS MARCUS (Assoc. M. '43), Office Engr., City Engrs. Office, Room 21, City Hall, New Orleans, La.

BURMEISTER, ROBERT AUGUST (Assoc. M. '43), Laboratory Engr., City Testing Laboratory, 3515 West Clybourn St., Milwaukee 8, Wis.

CALDERON CORLETO, TIBURCIO (Jun. '42), Civ. Engr., Empresa de Agua y Luz Electrica, Tegucigalpa, D.C., Honduras.

CARVER, CARL FRANKLIN, JR. (Jun. '43), With U.S. Army, 1315 Richmond St., Swissvale, Pa.

CONTI, ARNOLD WILLIAM (Assoc. M. '43), Lt., CEC, U.S.N.R., Bachelor Officers Quarters, Naval Air Station, Vero Beach, Fla.

CREAMER, WILCOX ASTEN (M. '43), Dist. Constr. Mgr., Pan Am. Airways, Army Post Office 675, Care, Postmaster, Miami, Fla.

CULLUM, GEORGE PIERCE, JR. (Jun. '43), Junior Structural Engr., TVA, Douglas Dam, Jefferson City (Res., 803 North 3d Ave., Knoxville), Tenn.

D'ANGELO, JOSEPH (Jun. '43), Plant Engr., Hamilton Standard Propeller, East Hartford, Conn. (Res., 85 Vanner St., Johnston, R.I.)

DARLING, HERBERT FRANKLIN (M. '43), Gen. Contr., 131 California Drive, Williamsville (Res., 790 Le Brun Rd., Eggertsville), N.Y.

DEVALVE, ALBERT STIEHLER (Jun. '43), Private, Air Force, U.S. Army, 59 Pacific St., Baldwin, N.Y.

DICKEY, WALTER LINNAEUS (Assoc. M. '43) Lt., CEC, U.S.N.R., U.S. Naval Dry Docks, Hunters Point, San Francisco, Calif.

DUCKERING, CHARLES ELMHIRST (Assoc. M. '43), Associate Engr. (Civ.), U.S. Engr. Dept., 74 New Montgomery St., San Francisco (Res., 1257 Brunswick St., Daly City 25), Calif.

DUGGER, EUGENE FRANK (M. '43), Gen. Mgr., Newport News Waterworks Comm., City Hall, Box 545, Newport News, Va.

ELMIGER, FREDERICK JOHN (Jun. '43), Ensign, CEC, U.S.N.R., Regimental Staff, 1st Constr. Regiment, Care, Fleet Post Office, San Francisco, Calif.

FAIRHALL, WILLIAM MARKLEY (Assoc. M. '43), With U.S. Army, 1333 Birchwood Ave., Rogers Park, Chicago, Ill.

FENWICK, HERBERT SIDNEY (M. '43), Master Checker, Aircraft, Fisher Body Div., Gen. Motors Corp., Detroit (Res., 811 Bush St., Jackson), Mich.

FOUSHEE, JOHN GILES (Jun. '42), Care, U.S. Submarine and Naval Air Station, Box 360, St. Thomas, Virgin Islands.

FOX, JOSEPH HENRY (Assoc. M. '43), (Joseph H. Fox & Co.), 1601 Empire Bldg., Birmingham, Ala.

GIESE, JOHN ROSSI (M. '43), Staff Member, Modjeski & Masters, State Street Bldg., Harrisburg (Res., 3105 Yale St., Camp Hill), Pa.

GILLENWATERS, FRANKLIN GEORGE (Jun. '43), Junior Bridge Engr., State Div. of Highways, Box 1499 (Res., 2540 Ninth Ave.), Sacramento, Calif.

GILLIAM, CYRIL OLIVER (Assoc. M. '43), Civ. Engr. and Archt., Home Builders Bldg. (Res., 2222 North Evergreen St.), Phoenix, Ariz.

GILMAN, LYDON AINSWORTH (Assoc. M. '43), Engr. Mosher Steel Co., Box 279, Houston, Tex.

GOLDSMITH, FRED (Assoc. M. '43), 116 Carpenter Ave., Crestwood, N.Y.

GUTHRIE, PERCY LEE (Assoc. M. '43), Civ. Engr., TVA, Douglas Dam, Jefferson City, Tenn. (Res., 1325 South 18th Ave., Birmingham, Ala.)

GWINN, ABNER (M. '43), Res. Engr., Horner & Shifrin, 803 Shell Bldg., St. Louis (Res., 26 B Pulaski Ave., Fort Leonard Wood), Mo.

HAGADORN, LESTER THEODORE (Assoc. M. '43), Senior Engr., Wilson & Co., Box 518, Salina, Kans.

HARLEY, FRANK ELLSWORTH (Assoc. M. '43), Civ. Engr., Fair Lawn Radburn Trust Co. Bldg., Fair Lawn, N.J.

HIATT, ALFRED RONALD (M. '43), Associate Engr., U.S. Engr. Office, Vicksburg, Miss.

HIESTAND, HERBERT HAROLD (Affiliate '43), Asst. Treas., Engr., Griffith Co., 502 L.A. Ry. Bldg., Los Angeles 15, Calif.

HIRST, JULIAN FRAVEL (Jun. '43), Capt., Air Corps, U.S. Army, Purcellville, Va.

HOLDEN, JAMES TOLMAN (Jun. '43), Ensign, U.S.N.R., 477 West Broadway, Granville, Ohio.

KAMINSKI, WILLIAM STANLEY (Assoc. M. '43), Capt., Corps of Engrs., U.S. Army, U.S. Engr. Office, Mobile, Ala.

KAUER, THEODORE JOSEPH (M. '42), Asst. Secy., Am. Concrete Pipe Assn., 1149 Munsey Bldg., Washington, D.C.

KEILCH, JOHN FITZGERALD (Assoc. M. '43), Lt. (jg), U.S.N.R., 1744 South Xanthus St., Tulsa, Okla.

KESSLER, HERBERT WILLY (Assoc. M. '43), Field Engr., Federal Public Housing Authority, Box 657, Killeen, Tex.

KRUSZEWSKI, EDWIN THOMAS (Jun. '43), Junior Stress Analyst, Glenn L. Martin Co. (Res., 4900 Ross Rd.), Baltimore, Md.

KULP, BURR ROBERT (M. '43), Chf. Engr., C. & N.W. Ry. and C.St.P.M. & O. Ry., 400 West Madison St., Chicago, Ill.

LARSON, ARTHUR HELMAR (Jun. '43), Lt. (jg), U.S.N.R., 811 Crotona Park North, New York 60, N.Y.

LEARY WILFRED JOHN (M. '43), Runway and Road Engr., Transportation Supt., Pleasantville Constructors, Inc., 10 East 40th St., New York, N.Y. (Res., 321 South Excelsior St., Butte, Mont.)

LEH, ALDEN WESLEY (Assoc. M. '43), Project Engr., The Austin Co., Pittsburg, Calif.

LI, ROBERT KI-CHEONG (Jun. '43), Designing Draftsman, Stone & Webster Eng. Corp., 49 Federal St., Boston (Res., Y.M.C.A., Newton), Mass.

LINDER, ROBERT EARL (Jun. '43), Ensign, U.S.N.R., 360 Baldwin Ave., Sharon, Pa.

LONGWELL, WILLIAM FRANCIS MERWIN (Assoc. M. '43), Winchester Hall, Yale Univ., New Haven, Conn.

LOUREE, CHARLES HAROLD (Assoc. M. '43), Care, Ingalls Iron Works Co., 816 Masonic Temple Bldg., New Orleans, La.

LUNA, WILLIAM AUGUST (Assoc. M. '43), Safety Engr., Constr., Liberty Mutual Ins. Co., 10 Rockefeller Plaza (Res., 2600 Creston Ave., Apt. E), New York, N.Y.

MACKAY, THOMAS ROBERT (Jun. '43), Asst. Engr. (Hydr.), U.S. Geological Survey, 302 East State St., Ithaca, N.Y.

MAIER, WILLIAM (M. '43), Dist. Engr., State Dept. of Public Works, 216 Civil Court Bldg. (Res., 2015 Joseph St.), New Orleans, La.

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MELCHER, MAX ALLEN (Jun. '42), Lt., U.S. Army, Box 61, La Grange, Tex.

MOLKE, ERIC CARL (M. '43), Chf. Engr., Roberts & Schaefer Co., 307 North Michigan Ave., Chicago (Res., 723 Forest Ave., Highland Park), Ill.

MOUSEL, PAUL WELTY, (Assoc. M. '43), Coordinating Utilities Engr., Davis & Wilson, Box 342, Hastings (Res., 3316 South 29th St., Lincoln), Nebr.

NEFF, JOHN ELWOOD (Jun. '42), 2500 East 35th South, Salt Lake City, Utah.

NELSON, PHILIP PAGE (Assoc. M. '42), Lt. (jg), CEC, U.S.N.R., 101 Chandler Court, Williamsburg, Va.

NEWMAN, JACK LEWIS (Assoc. M. '43), Maj., Corps of Engrs., U.S. Army, U.S. Engr. Office, Box 1739, Sacramento, Calif.

NEWMAN, JAMES BLACKSTONE (Jun. '43), Ensign, CC-V(S), U.S.N.R., Production Div., U.S. Navy Yard, Charleston, S.C.

OSNDORFF, ROY LEE (Assoc. M. '43), Engr., Design and Constr., District of Columbia Water Div., 312 District Bldg., Washington, D.C. (Res., 4624 Twenty-third Rd., North, Arlington, Va.)

PEIGHTAL, PERCIVAL LYLE (Assoc. M. '43), Care, Marine Eng. Dept., Oregon Shipbuilding Corp., Portland, Ore.

PIEN, CHUNG LING (Assoc. M. '43), Mech. and Structural Designer and Checker, Designers for Industry, Inc., 2915 Detroit Ave. (Res., 3200 Franklin Blvd.), Cleveland, Ohio.

PIERCE, DEWEY ORVILLE (Assoc. M. '43), 701 Nichols St., Fulton, Mo.

PORTERFIELD, WILLIAM ALEXANDER (Affiliate '43), Vice-Pres., The Union Metal Mfg. Co., 1432 Maple Ave., N.E. (Res., 325 Twenty-second St., N.W.), Canton, Ohio.

RAPPIN, ISIDOR DORR (M. '43), Chf. Engr., Barrett & Hilp, 918 Harrison St. (Res., 54 Palm Ave.), San Francisco, Calif.

REID, JOHN LEWIS (Assoc. M. '43), Lt., CEC, U.S.N.R., Washington, D.C. (Res., 2400 Alexander Ave., Alexandria, Va.)

RICHARDS, STEPHEN CARPENTER (Assoc. M. '43), Gen. Supt., Walsh Constr. Co., and J. Rich Steers, Inc., Box B, Bergen Station, Jersey City, N.J. (Res., 16 Byron Ave., White Plains, N.Y.)

ROBERTSON, WILLIAM HOSEA (Jun. '43), Asst. Engr. (Civ.), War Dept., Box 80, Vicksburg, Miss.

ROLLENT, VICTOR TWINING (Assoc. M. '43), Estimator, Jay Downer, Idlewild Airport, 159th St., Jamaica South (Res., 501 Tulip Ave., Floral Park), N.Y.

SCHULTZ, THEODORE PAUL, JR. (Jun. '42), Eng. Aid, Public Roads Administration, Whitehorse, Yukon Territory, Canada.

SCOTT, HAROLD AUSTIN, SR. (Assoc. M. '43), Associate Engr., Head, Drainage Section, U.S. Engr. Office, Box 4970 (Res., 4134 Dover Rd.), Jacksonville, Fla.

SCOTT, RICHARD LUCAS (Jun. '43), Transitman and Insp., Alabama Power Co., Gorgas, Ala.

SEAVER, GEORGE ARTHUR (M. '43), Engr., George J. Glover, Co., Inc., 1430 Whitney Bldg. (Res., 1237 Leonore St.), New Orleans, La.

SEARISTANIAN, ARTHUR JACOB (Assoc. M. '43), Insp., Norton Co., 1 New Bond St. (Res., 74 Fox St.), Worcester, Mass.

SHEETS, WILLIAM LAWRENCE (Assoc. M. '43), Res. Engr., Stone & Webster Eng. Corp., Box 750, Williamsport (Res., 414 West 4th St., Williamsport 1), Pa.

SHOEMAKER, ROBERT RADCLIFFE (M. '43), Chf. Engr., Harbor Dept., City of Long Beach, 1333 El Embarcadero (Res., 2926 Cedar Ave.), Long Beach, Calif.

SHUMAKER, CLARENCE ARNOLD (Assoc. M. '43), 1st Lt., Corps of Engrs., U.S. Army, 806 East Main St., Prescott, Ark.

SIMMONS, CHESTER THOMAS (Assoc. M. '43), Office Engr., Constr. Div., Koppers Co., Kobuta, Pa. (Res., 1339 McCutcheon Rd., Richmond Heights, Mo.)

SMYTH, WILLIAM HARRIS (M. '43), 1150 Park Ave., New York, N.Y.

SNOOK, STANFORD PHILLIP (Jun. '43), Engr. Officer Candidate, U.S. Army, 1461 Twenty-sixth Ave., San Francisco, Calif.

STEELE, DONALD JEFFERSON (Assoc. M. '43), Senior Highway Engr., U.S. Public Roads Administration, 720 Phelan Bldg., San Francisco, Calif.

STEELE, THOMAS LINDSEY (Assoc. M. '43), Lt. (jg), CEC-V (S), U.S.N.R., 610 South Florence, Springfield, Mo.

STEELMAN, COURTLAND (Assoc. M. '43), Asst. Mgr., Wabash River Ordnance Works, E. I. du Pont de Nemours & Co., Inc., Box 260 (Res., 228 South 21st St.), Terre Haute, Ind.

TASHJIAN, MEGURDICH DAN (Assoc. M. '43), Chf. Field Engr., Iglehart, Caldwell & Scott, Inc., St. Albans Naval Hospital (Res., 119-09 One hundred and seventy-eighth St.), St. Albans, N.Y.

THOMAS, EDWARD HARPER (Assoc. M. '43), Bridge Designing Engr., Washington Toll Bridge Authority, Box 1583, Tacoma, Wash.

THOMAS, JOHN IRA (M. '43), Prin. Engr., U.S. Engr. Office, 1410 North East 2d Ave., Miami, Fla.

TOMLIN, ROBERT KINGSLEY (M. '43), Editor, *Construction Methods Magazine*, 330 West 42d St., New York, N.Y.

TRAXLER, ROBERT WINGATE (Jun. '42), Draftsman, Am. Bridge Co. (Res., 751 Carolina St.), Gary, Ind.

TROTTER, JOSEPH PIERCE (M. '43), Chf. Engr., Ernest Constr. Co., 174 Louisville St. (Res., 58 Glenwood Ave.), Mobile, Ala.

TRYGG, CHARLES EVERETT (Jun. '43), Ensign, E-V (G), U.S.N.R., McGregor, Iowa.

VAN REUTH, ARTHUR GEATTY (Assoc. M. '43), Asst. Engr., The Baltimore Transit Co., 410 Equitable Bldg., Baltimore 2 (Res., 4604 Northwood Drive, Baltimore 12), Md.

VERMILYA, FLOYD DURLAND (M. '43), Chf. Insp., Sanderson & Porter, 1111 Rialto Bldg. (Res., 214 East Armour Blvd.), Kansas City, Mo.

VICKERY, CHARLES WATSON, JR. (Affiliate '43), Senior Statistician, Office of Defense Transportation, 4117 Interstate Commerce Comm. Bldg., Washington, D.C.

WAFLER, WILLIAM (Jun. '43), Draftsman, Boeing Airplane Co. (Res., 426 South Hillside), Wichita, Kans.

WAUGH, JAMES HARRY (Assoc. M. '43), Road Design Engr., State Dept. of Highways, Baton Rouge, La.

WIGGINS, DONALD COVEY (Jun. '43), Ensign, CEC, U.S.N.R., U.S. Naval Constr. Training Center, Camp Peary, Va.

WILDSCHUTE, HENRY BALDWIN (Assoc. M. '43), San. Engr., Greeley & Hansen, 6 North Michigan, Chicago, Ill. (Res., Waterview Apartments, Apt. N-2, Portsmouth, Va.)

WILLIAMS, LESLIE (Assoc. M. '43), Engr.-Director, Governor's Comm. on Metropolitan Transportation, 14 College St., Providence, R.I.

WILSON, JAMES MALCOLM (Jun. '43), Ensign, CEC-V (S), U.S.N.R., 5314 Riggs Rd., Overland Park, Kans.

WILSON, JOHN MERLIN (Jun. '42), 2d Lt., U.S.M.C., Pyatt, Ark.

ZACH, LEON HENRY (M. '43), Chf., Site Planning Unit, Eng. Branch, Constr. Div., Office, Chf. of Engrs., War Dept., Temporary H, Twenty-third St., N.W. (Res., 2630 Adams Mill Rd., Apt. 201), Washington, D.C.

MEMBERSHIP TRANSFERS

BEALL, JOEL CHAMBLESS (Jun. '37; Assoc. M. '43), Associate Engr., Dept. of Public Health, Atlanta (Res., Vineville Court, Apt. D-3, Macon), Ga.

BRAY, OSCAR SIMON (Assoc. M. '35; M. '43), Structural Engr., Jackson & Moreland, 31 St. James Ave., Boston, Mass.

BRENNAN, WILLIAM ANDERSON (Assoc. M. '33; M. '43), Coordinator, Control Instrument Co., Inc., Bush Terminal (Res., 450 Clinton Ave.), Brooklyn, N.Y.

CASSELL, DAVID BENNETT, JR. (Jun. '34; Assoc. M. '43), Constr. Engr., Bates & Rogers Constr. Corp., 111 West Washington St., Chicago, Ill. (Res., 1136 South Gramercy Drive, Los Angeles, Calif.)

DECKER, ELBERT LEROY (Assoc. M. '30; M. '43), Senior Engr., War Relocation Authority, U.S. Indian Irrig. Service, Parker, Ariz.

TOTAL MEMBERSHIP AS OF JUNE 9, 1943	
Members	5,924
Associate Members	7,234
Corporate Members	13,158
Honorary Members	33
Juniors	5,580
Affiliates	73
Fellows	1
Total	18,845
(Total June 9, 1942	17,807)

FORBIS, JOHNSON LINVILLE (Jun. '33; Assoc. M. '43), Field Engr., Stone & Webster Eng. Corp., Box 527 (Res., 5332 Gladstone Pl., Apt. B), St. Louis, Mo.

GARDNER, WERNER CLARKE (Assoc. M. '40; M. '43), City Engr., Supt., Water Dept., City Hall (Res., 11 Forest Lane), Salisbury, Md.

GIERASCH, AIDEN REDMOND (Jun. '30; Assoc. M. '43), 1st Lt., Corps of Engrs., U.S. Army, Headquarters S-4, Engr. Replacement Training Center, Fort Belvoir, Va.

GORDANIER, JOHN WEDGEWOOD (Jun. '32; Assoc. M. '42), Lt. Comdr., CEC, U.S.N., 900 Book Tower, 1249 Washington Blvd., Detroit, Mich.

HARRIS, EDWARD HOOPER (Jun. '39; Assoc. M. '43), With Remington Arms Co., Inc., Barnum Ave., Bridgeport, Conn.

HECHMER, WILLIAM LOUIS (Jun. '38; Assoc. M. '43), Engr.-Estimator, Mohler Constr. Co., 1223 Connecticut Ave., N.W., Washington, D.C. (Res., 400 North George Mason Drive, Apt. 1, Arlington, Va.)

HUIE, SAMUEL SZE LIEN (Jun. '36; Assoc. M. '43), Geodetic Computer, Corps of Engrs., U.S. Army, 8422 One hundred and eighth St., Richmond Hill, N.Y.

JENSEN, VERNON PETER (Assoc. M. '33; M. '43), Research Associate Prof., Theoretical and Applied Mechanics, Univ. of Illinois, 103 Talbot Laboratory, Urbana, Ill.

JOHNSON, CHARLES FRANKLIN (Assoc. M. '39; M. '43), Chf. Engr., Commrs. of Sewerage of Louisville, 422 Marion E. Taylor Bldg. (Res. 202 Pennsylvania Ave.), Louisville, Ky.

KNOX, VERNON EUGENE (Jun. '34; Assoc. M. '43), Engr., Technical Service Dept., Compania de Petrolio Lago, Apartado 849, Caracas, Venezuela.

LESLIE, ALEXANDER (Jun. '38; Assoc. M. '43), Capt., Royal Engrs., 5 Douglas Gardens, Edinburgh 4, Scotland.

LETOURNEAU, DORIA GEORGE (Jun. '27; Assoc. M. '37; M. '43), Project Mgr., Braum & Stuart Co., Broad St. Station Bldg., Philadelphia, Pa. (Res., 176 Madison Ave., Mount Holly, N.J.)

LIERBOE, RINARD THEODORE, JR. (Jun. '35; Assoc. M. '43), Associate Civ. Engr., U.S.N., Public Works Office, Charleston, S.C.

MCIVER, ANGUS VAUGHN (Assoc. M. '25; M. '43), Archt.-Engr., Box 1945, Great Falls, Mont.

MURS, FREDERICK ROSS, JR. (Jun. '26; Assoc. M. '31; M. '43), Gen. Supt., San Francisco Bridge Co., 503 Market St., San Francisco, Calif.

PHILBRICK, WILLIAM HUNT (Jun. '36; Assoc. M. '43), Asst. Div. Engr., State Highway Dept., Box 382 (Res., 12 Wilber St.), Keene, N.H.

RAIDER, HARRY ADAM (Assoc. M. '10; M. '43), Pres. and Gen. Mgr., Chinese Eng. & Development Co., Inc., 51 Canton Rd., Shanghai, China.

ROSENGARTEN, CARL ALFRED (Assoc. M. '38; M. '43), Architectural Engr., The Ballinger Co., 105 South 12th St., Philadelphia (Res., 1614 Ridgeway Rd., Upper Darby), Pa.

STRATTON, JAMES HOBSON (Assoc. M. '37; M. '43), Col., Corps of Engrs., U.S. Army, 2824 South Joyce St., Arlington, Va.

TELLEPSEN, HOWARD TELLEF (Jun. '36; Assoc. M. '43), Vice-Pres., Tellepsen Constr. Co., 3900 Clay Ave., Houston, Tex.

ZIEGLER, AMOS ADDIS, JR. (Jun. '27; Assoc. M. '43), Designing and Estimating Engr., Am. Bridge Co., 71 Broadway, New York (Res., 8309 Talbot St., Kew Gardens), N.Y.

REINSTATEMENTS

BUCHANAN, GEORGE HENRY, Assoc. M., reinstated May 21, 1943.

CARDER, WILLIAM BURDES, Assoc. M., reinstated May 25, 1943.

DIBERT, HERBERT MCMILLEN, M., reinstated May 24, 1943.

LICHTENSTEIN, HARRY, Assoc. M., reinstated May 25, 1943.

ROONEY, WILLIAM FRANCIS, M., reinstated May 24, 1943.

SULLIVAN, JOHN DONALD, Assoc. M., reinstated May 26, 1943.

RESIGNATIONS

HUFFINE, WILLIAM BYRD, Assoc. M., resigned May 14, 1943.

JOBUSCH, FRED HENRY, Jun., resigned May 25, 1943.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

JULY 1, 1943 NUMBER 7

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junio.	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i.e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BOECK, RALPH ELMER, Milwaukee, Wis. (Age 38) (Claims RCA 7.0 RCM 6.0) June 1928 to date Structural, Mining, and Welding Engr., Worden Allen Co., Cons. and Contr. Engrs. and Structural Steel Fabricators.

BROWNE, WALTER ESTAUGH, Milwaukee, Wis. (Age 45) (Claims RCA 7.0 RCM 12.0) 1931 to date in private practice.

BUARD, ROBERT ERARISTE, Washington, D.C. (Age 47) (Claims RCM 18.4) March 1938 to date Archt. Engr., with U.S. Dept. of Interior, Indian Affairs, and (since June 1942) Federal PHA; previously Res. Engr., PWA.

CARLSON, CHARLES ARTHUR, Boulder City, Nev. (Age 50) (Claims RCA 4.5 RCM 19.8) Nov. 1941 to date Staff Engr., Basic Magnesium, Inc., Las Vegas, Nev.; previously Bldg. Contr., Columbus, Ohio.

COHEN, SIGMUND (Assoc. M.), Detroit, Mich. (Age 44) (Claims RCA 4.4 RCM 6.6) Nov. 1940 to date with U.S. Army, as Capt., Corps of Engrs., and (since March 1942) Major; previously with Dept. of Public Works, Detroit, as Asst. Structural Engr. and First Asst. to Associate Engr.

DAWSON, JAMES WEAVER, Texarkana, Ark. (Age 59) (Claims RCA 17.3 RCM 11.6) 1941 to 1943 Water and Sewer Engr., Red River Ordnance Depot; previously in private practice of civil engineering.

FORTIER, ERNEST CLEVELAND (Assoc. M.), Redwood City, Calif. (Age 48) (Claims RCA 13.4 RCM 10.7) April 1930 to date with Office of Indian Affairs, U.S. Dept. of Interior, as Associate Engr., Asst. to Director of Irrigation, Superv. Engr., and Dist. Engr.

GENTLEMAN, LAWRENCE MILES (Assoc. M.), Watertown, Mass. (Age 44) (Claims RCA 5.6 RCM 6.3) Feb. 1941 to date Div. Engr., Shreve, Lamb & Harmon-Fay, Spofford & Thorndike; previously Asst. Engr., Senior Civ. Engr., and Associate Civ. Engr., Metropolitan Dist. Water Supply Comm., Boston.

GILBERT, JACK HITE, New Orleans, La. (Age 42) (Claims RCA 9.0 RCM 10.6) May 1941 to date Lt. Comdr., CEC, U.S.N.R.; previously Office Engr., and Senior Res. Engr., Tennessee Dept. of Highways & Public Works, Jackson, Tenn.

GLAZE, VERNON LOUIS, Sacramento, Calif. (Age 53) (Claims RCA 1.8 RCM 27.8) Oct. 1933 to date with U.S. Engr. Office, as Field Res. Engr., Area Engr., Constr. Engr., and (since May 1941) Area Engr.

HOGE, WILLIAM MORRIS, Fort Riley, Kans. (Age 49) (Claims RCA 1.4 RCM 11.0) Aug. 1922 to date with U.S. Engrs., as Asst. to Dist. Engr., Instructor, Asst. to Pres., Mississippi River Comm., Dist. Engr., Executive Officer, and (at present) Brigadier General, 9th Armored Div., Ft. Riley, Kans.

HOMAN, WILLIAM JENNINGS, Salt Lake City, Utah. (Age 44) (Claims RCA 9.2 RCM 7.8) Aug. 1938 to date with U.S. Engr. Office, as Associate Engr., Engr.-in-charge, Chf. Engr. and (since Dec. 1942) Chf., Civ. Works Subdiv.

JOHNSTON, WILLIAM CARLETON (Assoc. M.), Little Rock, Ark. (Age 44) (Claims RCA 11.8 RCM 8.2) March 1943 to date Engr., NYA; previously Engr., MacCrea-Bair-Lefever; Chf. Engr., Associated Archts. and Engrs. of Little Rock; Asst. Engr., Holway & Cochrane; with Arkansas Highway Dept. in various capacities.

JONES, THOMAS HENRY (Assoc. M.), Rockville Centre, N.Y. (Age 46) (Claims RCA 7.4 RCM 12.7) Feb. 1943 to date Lt. Comdr., CEC, U.S.N.R.; previously Asst. Gen. Supt., Walsh-Driscoll Co., Trinidad, B.W.I.; Chf. Engr., Elmhurst Contr. Co., Inc., New York City; Deputy City-Wide Engr. and Deputy Director, WPA, New York City.

KAPSCHULL, CHARLES CONRAD, Deerfield, Ill. (Age 51) (Claims RCA 3.6 RCM 21.1) Feb. 1942 to date Project Mgr., W. E. O'Neil Constr. Co., Great Lakes, Ill.; previously Pres. and Gen. Mgr., Kapschull-Davis Co., Gen. Contrs., Chicago, Ill., and Gen. Mgr. and member of firm, Kapschull & Co., Gen. Contrs., Deerfield.

KOTHE, STANLEY WEYANDT, Ellwood City, Pa. (Age 43) (Claims RCA 4.2 RCM 5.7) Dec. 1941 to date Constr. Estimator, Constr. Dept., Westinghouse Elec. and Mfg. Co., Pittsburgh; previously Office Engr. and Purchasing Agent, Matthew Leivo & Sons, Gen. Contrs., New Castle, Pa.; Office Engr., W. F. Trimble & Sons Co., Gen. Contrs., Pittsburgh; Draftsman and Structural Engr. with Edwin Howard, Archt., Butler, Pa.

LAMM, ALBERT RICARDO, Richmond, Va. (Age 43) (Claims RCA 0.5 RCM 11.5) June 1942 to date not on engineering; Oct. 1941 to June 1942 ill; previously Structural Designer, Baskervill & Son, Richmond; Mgr. of his own firm in Copenhagen, Denmark.

LEIDER, MAX, Waukegan, Ill. (Age 37) (Claims RCA 1.8 RCM 5.3) July 1941 to date Lieut., CEC, U.S.N.R., acting as Asst. to Public Works Officer, 9th Naval Dist.; previously with Harry M. Lewis, Real Estate Manager Agent, as Engr. and Supervisor; also Teacher of technical subjects, New York City Board of Education.

LIEN, HAROLD LOUIS, Kirkwood, Mo. (Age 47) (Claims RCA 13.5 RCM 8.1) 1930 to date with Missouri Highway Dept., Div. 6, Kirkwood, Mo., as Designer, Asst. Plans and Survey Engr., and (since 1938) Div. Survey and Plans Engr.

LUCAS, HAROLD CECIL, Louisville, Ky. (Age 35) (Claims RCA 3.0 RCM 6.8) July 1929 to date with American Creosoting Co. and its subsidiaries, in various capacities, since March 1943 as Chf. Engr.

MARTIN, ROBERT EMMETT (Assoc. M.), Boston, Mass. (Age 35) (Claims RCA 1.8 RCM 9.5) March 1942 to date Engr., Stone & Webster Eng. Corporation; previously with Havens & Emerson, Cons. Engrs., Fort Knox, Ky., J. S. Watkins, Cons. Engr., Lexington, Ky.; Kentucky Dept. of Highways.

METROS, BENJAMIN CHARLES, Chicago, Ill. (Age 43) (Claims RCA 8.0 RCM 11.5) Dec. 1942 to date Asst. Subway Engr. (Constr.-Administrative), Dept. of Subways, Chicago; previously Supt. (Constr.), Jamaica Bus Contrs.; Asst. Subway Engr., Dept. of Subways & Superhighways, Chicago.

PHILLIPS, ORLEY OLIVER (Assoc. M.), Lakewood, Colo. (Age 39) (Claims RCA 8.0 RCM 6.9) March 1941 to date with Prouty Bros. Eng. Co. as Chf. Designer and Engr., and (since Feb. 1942) Prin. Asst.; previously Engr. Tipton Eng. Co.; member of firm, Sanford & Phillips, Cons. Engrs., Colorado Springs.

PRICE, EDWARD LEO, Moultrieville, S.C. (Age 44) (Claims RCA 2.1 RCM 16.8) Jan. 1943 to date Senior Draftsman, Hull Sec., Charleston (S.C.) Shipbuilding and Drydock Co.; previously Senior Civ. Engr. (P-5), Corps of Engrs., U.S. Dist. Engr. Office, Memphis; Senior Civ. Engr. (P-5), Utilities Div., Corps. of Engrs., Camp Davis, N.C.; with PWA.

RAWLINS, GEORGE SKEVINGTON (Assoc. M.), Charlotte, N.C. (Age 38) (Claims RCA 9.4 RCM 7.7) Sept. 1941 to Jan. 1942 member of firm, and Feb. 1942 to date Executive Vice-Pres., J. N. Pease & Co.; previously in private practice, Charlotte, N.C.

SAUER, HERBERT OSWALD (Assoc. M.), Baltimore, Md. (Age 55) (Claims RCA 4.0 RCM 23.7) June 1914 to date with Consolidated Gas, Elec. Light & Power Co., Baltimore, as Designer, Asst. to Elec. Engr., and (since Oct. 1919) in charge of Elec. Eng. Drafting Dept.

SCHUMANN, GEORGE EDGARD (Assoc. M.), East Cleveland, Ohio. (Age 43) (Claims RCA 5.2 RCM 9.7) Oct. 1938 to date with Wilbur Watson and Associates, since Feb. 1943 as Asst. Chf. Engr.; previously with Arthur G. McKee Co., Cleveland.

SMALL, GILBERT, Providence, R.I. (Age 53) (Claims RCA 4.7 RCM 18.0) July 1925 to date Engr., City Engr's. Office, Providence, R.I.

SMITH, RALPH ADAMS (Assoc. M.), Holyoke, Mass. (Age 46) (Claims RCA 5.6 RCM 15.0) July 1920 to date with Holyoke (Mass.) Water Power Co., as Engr. and (since Dec. 1926) Chf. Engr.

THOMPSON, SAMUEL HYDE (Assoc. M.), Washington, D.C. (Age 44) (Claims RCA 6.7 RCM 7.5) Dec. 1940 to date Prin. Engr., Chf. of Energy Resources Unit, National Resources Planning Board, and Secy., Energy Resources Comm.; previously Engr. and Senior Engr., Federal Power Comm., Washington, D.C.

VASSILIEV, SERGIUS ALEXANDER, Brewster, N.Y. (Age 62) (Claims RCA 2.0 RCM 31.2) 1941 to date with Sanderson & Porter, and Machine & Tool Designing Co., New York City and Allied Aviation Corporation, Baltimore, Md.; previously Pres., United Eng. and Export Co.

VREATT, RAYMOND, Elmira, N.Y. (Age 39) (Claims RCA 3.5 RCM 6.0) June 1926 to